"STUDIES ON CERTAIN SEED TECHNOLOGICAL ASPECTS OF BELLARY (*Allium cepa* L.) AND AGGREGATUM ONIONS"

Thesis submitted in partial fulfilment of the requirements for the Degree of Master of Science (Agriculture) in Seed Technology to the Tamil Nadu Agricultural University, Coimbatore.

By

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CERTIFICATE

This is to certify that the thesis entitled **"Studies on certain seed technological aspects of bellary (Allium cepa L.) and aggregatum onions"** submitted in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE (Agriculture) in SEED TECHNOLOGY to the Tamil Nadu Agricultural University, Coimbatore is a record of bonafide research work carried out by Mr. P. MURUGESAN under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes on that the work has not been published in part or full in any scientific or popular journal or magazine.

Place : Coimbatore

Date : 1.3.'94

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TO

MY SISTERS,
RAMALAKSHMI &
MUTHUMARI

Acknowledgement

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Abstract

ABSTRACT

STUDIES ON CERTAIN SEED TECHNOLOGICAL ASPECTS OF BELLARY (Allium cepa L.) AND AGGREGATUM ONIONS

By

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Degree: Master Of Science(Agriculture) in Seed Technology

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Studies were conducted at the Department of Seed Technology, Tamil Nadu Agricultural University, Coimbatore with the seeds of bellary onion **(Allium cepa L.)** cv. Nasik red and aggregatum onion **(Allium cepa** var. **aggregatum)** cv. Mutlur local, to elicit information on the i) quality of size graded, seeds ii) seed deterioration pattern under ambient as well as at different Relative humidity regimes, iii) topography of seed senescence sequence and iv) hydration-dehydration treatment on the maintainence of viability and vigour as well as productivity.

The seed lots of both onions can be processed using ISS 170 wire mesh to improve the viability and vigour of seeds.

The bellary and aggregatum onion seeds treated with Thiram (2g/kg) can be stored safely in polyethylene bags for eight months under ambient conditions prevailing at Coimbatore.

The relative humidity played a major role in seed deterioration. The seeds of both bellary and aggregatum lost viability very steeply within a week. As the RH decreased (90 and 75%) the deterioration rate slowed down. Very little reduction occurred in the seeds stored at 50% RH.

Topographical staining of acceleratedly aged seeds of bellary onion revealed that the key tissues at the radicle region senescenced first folowed by the plumular region and then descended to hypocotyl region which culminated in the death of the embryo.

Hydration-Dehydration treatment with disodium phosphate solution (10^{-4}M concentration) can be given even to two-month old seeds with a soaking duration of two and half hours. The H-DH seeds showed improvement in vigour and germination besides, it maintained the potential in the subsequent storage period also.

The five-month old seeds of bellary and aggregatum onions given the hydration dehydration treatment and tested for their productivity in a field trial along with control seeds, gave significantly higher bulb yield (7.7 to 12% and 17 to 19%, in bellary and aggregatum, respectivley) with improvement in plant height.

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Introduction

CHAPTER I

INTRODUCTION

Onion (**Allium cepa** L.) is one of the most important commercial vegetable grown throughout the world. Among the fifteen vegetables listed by FAO, onion falls second to tomato in annual world production. It occupied an area of 1.79 M.ha with a production of 25.39 MT (FAO. 1988). The major onion producing countries are China, India, U.S.A, Russia, Japan, Spain, Turkey, Brazil and Egypt.

Onion is an ancient crop in India and was grown in an area of 2.36 lakh ha with an annual production of 31.81 lakh MT (Gill and Tomer, 1991). India's share in world production was about 8 per cent and occupied second position. In India, Maharashtra is the leading state in onion production accounting for more than 20% of the area and 30 per cent of production; the other major states being Guajarat, Karnataka, Tamil Nadu, Orissa, Madya Pradesh, Uttar Pradesh and Andhra Pradesh.

Among the onions, the large onion (bellary onion) is exclusively seed propagated while the small onion (aggregatum onion) is mostly vegetatively (bulb) propagated for commercial production except in few cases such as the Mutlur onion, a local variety of aggregatum onion, propagated through seeds. In contrast, invariably the bulbs are used in the both cases for seed production.

A formidable bottle neck in onion production is the non availability of guaranteed quality seeds of improved varieties and higher cost of seeds. Onion is a short-lived seed (Boswell et al., 1940) and retains viability for less than one year under ambient storage condition (Justice et al., 1977). Use of sub-standard seeds affect not only the field stand but also the productivity of the crop.

To improve seed quality, seed processing is an essential operation. Size grading improves both the physical and physiological quality of seeds. The germination and field emergence potential of large seeds were higher and gave increased yield (Emery, 1985).

Ageing is an inevitable and irreversible process in any living and so is the seed. Onion seeds loose their vigour and viability comparatively faster than seeds of other vegetables. Being a microbiotic seed, maintenance of viability under ambient condition would be a stupendous tasks which require special consideration. Temperature and relative humidity controlled storage of seeds would greatly minimise the physiological deterioration and consequently extend the shelf-life. But such facilities especially to carry over large quantity of seeds would be far reaching atleast for the present considering the cost involved for the required installations. Therefore, evolving improved sotrage methods and treatments to protect the seeds under hostile storage conditions with the use of easily available resources would greatly help the seed producers and ultimately benefit the growers. Further, the hazards from storage fungi comprising of several species such as **Aspergillus, Penicillium** etc. would also tell upon the longevity of seeds by reducing germination and causing seed discolouration. Use of appropriate fungicides to contain them is equally important.

Hydration-dehydration treatment was found to be effective for the maintenance of vigour and viability of onion seeds. It was also claimed that such treatments besides, improving vigour and viability augmented the productivity of the resulting crop.

Although informations are made available on certain aspects of bellary onion seeds, absolutely no work has been carried out in the country or elsewhere on the seed technological aspects of aggregatum onion and hence this primary study is of great significance.

To gain informations on some of the major problems confronted with onion seeds, some of the investigations were carried out with the seeds of bellary and aggregatum onion in this treatise at the Department of Seed Technology, Tamil Nadu Agricultural University, Coimbatore with the following objectives.

1. To standardise processing of seeds to resolve quality seeds in bellary and aggregatum onion.
2. To study the deterioration pattern of bellary onion seeds under accelerated ageing conditions.
3. To descern the influence of relative humidity levels on seed ageing pattern.
4. To evolve improvised storage methods to prolong the vigour and viability of bellary and aggregatum onion seeds under ambient conditions and,
5. To control the deterioration of stored seeds by hydration-dehydration treatment and to evaluate their effect on the production potential of the resultant crop.

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The literature pertaining to various aspects of the study were reviewed giving more emphasis on studies related to onion on given below aspect wise.

Effect of seed size on quality attributes

Borna and Haas (1969) reported that heavy seeds of onion (2.42 g 1000^{-1}) germinated earlier than the lighter seeds (3.23 g 1000^{-1}). Plants from heavy seeds grew better and produced more leaves than lighter seeds.

In Peanut Dharmalingam and Ramakrishnan (1981) reported significant differences in 100 seed weight, rate of emergence, field stand, number of primary leaves, dry weight of root shoot and pod yield between seed size grades.

Hussaini et al., (1984) reported that different sizes of maize seeds registered significant differences in germination, DMP and 100 seed weight upon grading.

Palanisamy and Ramasamy (1985) noted increase in shoot and root length and drymatter production with the increase in size of bhendi seeds upon grading.

The germination and field emergence percentage were higher for large seeds which increased the total number of bulbs and bulb yield in onion (Emery, 1985).

Vijayakumar and Dharmalingam (1988) reported that large size seeds of cole crops (cabbage, cauliflower, carrot and radish) were superior in respect to 100 seed weight, germination and vigour potential. Similar observations were reported in maize hybrid by Krishnaveni and Vanangamudi (1989). They also found that large size seeds performed better in storage and maintained higher viability and vigour in ageing test than small seeds.

Kalakannavar et al., (1989) reported that heavy wheat seeds performed better than light seeds. The germination percentage, root length, shoot length and vigour index enhanced as the seed size increased.

In soybean Reddy **et al.**, (1989) reported that seed size was negatively associated with protein content and the reverse with oil content. They established 100 seed weight differences in soybean seed sizes.

Gamiely et al., (1990) reported that larger sized seeds of onion gave good stand establishment.

Raveendranath and Gopal Singh (1991) had shown that sunflower seeds retained by 4.75 mm sieve and above registered higher seedling vigour as compared to seeds retained by 4.5 mm and ungraded ones.

Heather and Sieezka (1991) reported that large size seeds (2.0, 1.8 mm) of broccoli emerged quickly than small sized seeds (1.6 and 1.4 mm).

Studies carried out in chillies revealed that small size seeds (9/64" R) deteriorated faster than medium (8/64" R) or large (8/64"R) size seeds when they were acceleratedly aged (Thiagarajan, 1992).

Storage environment

High temperature and high moisture contents were detrimental to vegetable seeds and caused considerable reduction in the viability potential (Kirti Singh and Pandey, 1976).

Agrawal (1980) noted that the seed moisture as low as about 3 per cent would help in minimizing loss of seed viability in onion during storage.

Alison and Mathews (1984) reported that seed lots with low vigour had poor retention of viability in storage while high vigour lots had good storage potential.

The onion seeds stored at high temperature (45 ± 1C) lost viability very quickly. The rate of loss increased with increased in seed moisture content under anaerobic (sealed) condition (Agarwal et al., 1988).

The viability of onion seeds CV. Nasik red could be maintained for five years in cold storage. There was excessive leaching of electrolytes, soluble sugars and free amino acids from seeds stored at ambient conditions (16-35 C and RH 25-90 per cent) (Doijode, 1990). He also reported that reduction of moisture content from 10.0 to 6.5 - 7 per cent was beneficial for retaining high seed viability.

Storage containers

A package which is moisture proof or moisture resistant could be of value in prolonging the germination and vigour of seeds (Harrington, 1973).

Amaral et al., (1982) established that storage of onion seeds in sealed can for 12 months did not affect the germination rate or capacity even three months subsequent to cans were opened.

Vik (1985) reported that onion seeds dried to 8 per cent moisture content and kept in omnia (glass) packages at 15 C, in Pealpa (polythene + Aluminium + Paper) bags at 8 -

15 °C had a favourable effect on germination energy and retenion of germination rate, than control. The onion seeds stored in polythene pouches maintained viability beyond 20 months where as, seeds packed in cloth bags retained germination upto 16 months. (Hari Singh and Gurmit Singh, 1989 and 1990). The studies made by Singh (1990) showed that the onion seeds dried to 4 per cent moisture content and stored in cloth bag lost viability within 15 months, while the seeds stored in polythene pouches decreased 21 months after storage. Shelar et al. (1992) had shown that onion seeds with moisture content of 4 to 5 per cent could be stored for 360 days in aluminium foil and plastic bags with minimum germination of 70 per cent.

Effect of seed treatment

Jayaraj et al. (1987) reported that the seeds of tomato, chillies and brinjal treated with captan or thiram and stored in aluminium foil pouch maintained viability for 18, 12 and 12 months, respectively under ambient conditions.

Jacqueline (1988) reported that combined application of thiram and bavistin on brinjal seeds prior to storage recorded maximum germination and vigour over a period of 18 months. Aluminium foil pouch was efficient over polyethylene bag and cloth bag.

Vijayakumar *et al.* (1991) reported that bellary onion seeds treated with captan 75 per cent WDP at 2 g kg^{-1} at 8 per cent moisture content and packed in 700 guage polyethylene bag maintained good viability (more than 77 per cent) where as the seed stored in cloth bag lost germination quickly (35 per cent after ten months).

Seed treatment with five different chemicals (Thiram, Captan, Captafol atonik and cytozyme) either alone or in combination failed to increase the shelf-life of onion seeds beyond one year under ambient storage conditions (Gupta, 1991).

Effect of relative humidity on seed deterioration

Loss of viability and vigour of seed were influenced by various factors of which relative humidity and temperature of the storage environment formed the two most important factors influencing seed quality during storage (Agrawal, 1982).

It was not generally realised how quickly the seeds might deteriorate under certain conditions. As early as 1948, Clarks indicated that only few days of exposure to high atmospheric humidity (100 per cent RH) and high temperature (29 C) could cause significant reduction in the viability of onion seeds. Gane (1948) found that onion seeds could be stored safely at 0 C and 30 per cent RH for two to three years.

Toole (1958) reported that onion seeds (13.2 per cent moisture content) with an initial germination of 94 per cent, when stored at 80 F and 80 per cent RH the germination per cent decreased to 12 per cent in 3 weeks.

Nutil (1964) on the other hand, reported that excessive dryness reduced the longivity of seeds. Roosta and Harington (1969) suggested that below 5-6 per cent moisture cucumber seeds deteriorted.

The seeds stored under desiccation, moisture level was showed a gradual increase in internal seed moisture and within 20 days, the moisture level increased from 10 to 11 per cent. Increased leaching of inorganic and organic substances were found to be associated with RH and temperature (Takayanagi and Murakami, 1968; Ching and Schoolcraft, 1968; Abdul-Baki and Anderson, 1970; and Bradnock and Mathews, 1970).

According to Alison **et al.** (1977) Pea seeds stored under extremely humid condition after 3 weeks of storage led to increased leakage of electrolytes. Viability began to decline after 6 weeks in humid storage at 25 C and after 2 days in 94 per cent RH at 45 C, but was maintained in both dry and intermediate humid condtions.

Doijode (1985) reported that onion seed deterioration was enhanced by high temperature and relative humidity during seed storage.

Carperter et al,. (1991) have observed that relative humidity and temperature during storage were important in retaining seed viability with RH having larger effect. Optimum condition suitable for storage was at 14 C and 26 per cent RH.

Charjan et al., (1992) reported that the humid storage conditions (63% and 92% RH) were detrimental to seed viability and vigour. Seeds of soybean could be safely stored under dry conditions (32% RH) upto next planting.

Seed senescence pattern

Ageing is an inevitable and irreversible process in any living being and seed is no exception. Roberts (1972) considered it reasonable to support that there could be a group of 'key cells' most of which have to remain functional for the seed to retain germinability. Banerjee (1978) considered that the mesocotyl region including the root and shoot meristems to be the most vital 'key tissue' in the seeds of onion and barely.

The study by Purkar et al., (1982) revealed that mesocotyl region of the seed including root and shoot meristems seem to be the most vital Key tissue in pea and wheat seeds. Krishnasamy (1985) reported the deterioration pattern of sorghum seeds employing topographical Tetrazolium test on progressively aged seeds, the first sign of deterioration was observed at the tip of the scuttelum followed by scuttelum bottom, aleurone layer, coleorhiza,root apex, Coleoptile shoot apex and lastly the middle portion of the scuttllum and mesocotyl region.

Krishnasamy et al., (1989) reported that the coleoptile was the first tissue to deteriorate in rice seeds followed by the epiblast, lateral scale, ventral scale, coleorhiza, plumule, radicle, mesocotyl and scuttellum.

Control of seed deterioration

Onion seeds lost the vigour and viability comparatively faster than seeds of other vegetables and it could not remain viable for more than one year under ambient condition (Justice et al., 1977).

Loss of viability of wheat, rice, jute, sunflower, pulses and several vegetable seeds under ambient and accelerated ageing cnditions were significantly slowed down by soaking the seeds half way during storage with water or dilute solutions (10^{-5} to 10^{-3} M) of a range of chemicals for 2-6 hr followed by drying back to its original weight (Basu, 1976). Hydration seed treatment with dilute solutions of disodium phosphate, sodium chloride at 20 to 50 mg per litre of water at 2 to 4 litre per kg of seeds for 2 to 6 hr increased viability in most seeds (Basu, 1977).

Dasgupta et al., (1977) reported that when stored wheat seeds treated with water or dilute solutions (10^{-5} to 10^{-3} M) of sodium chloride, disodium phosphate, soidum thiosulphate, oxalic acid, cystine, P-amino benzoic acid, EDTA, gallic acid and other chemicals slowed down the loss of vigour and viability and can be restored under natural and accelarated ageing conditions.

Stored 5-6 month old seeds of cotton cv. MCU-5 soaked in water for 3 hr for linted seeds and 1 hr for delinted seeds and dried to its original weight increased the percentage of germination from 73-82 as against 54 per cent for control seeds. An increase of 30 and 11 per cent for linted and delined seeds were recorded, respectively (Dharmalingam and Basu, 1978).

Rudrapal and Basu (1979) reported that hydration of 5 month-old wheat seeds soaked in sodium phosphate (dibasic 10^{-4} M) for 2 to 5 hr followed by drying back reduced the loss of vigour and viability. Hydration of 12 month-old rice seeds by moisture equilibration for 24 to 72 hr or by soaking in water for 6 hr followed by drying greatly reduced the deterioration of seeds (Basu and Pal, 1980).

Pathak and Basu (1980) found that hydration - dehydration treatment with water or tannic acid and P-hydroxy benzoic acid for freshly harvested seeds or very old deteriorated seeds was ineffective and but the chemicals showed slightly better effect than water.

Perl and Peder (1981) found that hydration dehydration treatment of acceleratedly aged pepper seeds kept their level of vigour for atleast two months following the treatment.

Hydration-dehydration treatment of stored sunflower seeds with or without chemicals effectively controlled loss of vigour and viability under different ageing conditions (Dey and Basu, 1982; Dharmalingam, 1983) and treated seed showed greater dehydrogenase activity and reduced lipid peroxidation.

Basu **et al.,** (1985) suggested that physio chemical treatment for mustard seeds slowed down seed deterioration by reducing lipid peroxidation and free radical formation and maintained better membrane integrity, higher amylase and dehydrogenase activity.

Doijode and Raturi (1987) reported that hydration dehydration treatment given to acceleratedly aged seeds of tomato and radish showed enhanced storability and viability.

Mandal (1987) reported that hydration for 6 hr and 8 hr with stored coriander and fennel seeds, respectively followed by drying showed better post aging germination per cent and seedling growth than control.

Hydration - dehydration treatment for 15 month-old onion seeds with sodium phosphate (10^{-4} M monobasic) and sodium sulphate (10^{-4} M) showed only minor additional advantage than 1) soaking in water for 6 hr 2) dipping for 5 minutes then kept covered for 2 hr. 3) Moisture equilibriation with water saturated atmosphere for 48 hr followed by slow drying back to original weight in all cases (Choudhuri and Basu, 1988).

Saxena et al. (1990) reported that hydration - dehydration of 6 month - old onion seeds cv. Nasik red with GA_3 (10^{-4} M) for 6 hr followed by drying back to its original weight significantly increased the germination per cent, seedling length and dry weight.

Dharmalingam (1990) reported that 8 month-old seeds of rice cv. ADT 36, Bhavani and Co.40 when hydrated with disodium phosphate (10^{-4} M) for 6 hr maintained 85 to 87 per cent germination after 32 months of storage compared with 16 to 45 per cent in control.

The large and small seeds of sunflower given the soaking treatments for 2 hr with water as well as dilute solution (2×10^{-5} to 2×10^{-4} M) of disodium phosphate sodium chloride, P-hydroxy benzoic acid and tannic-acid followed by drying back maintained high vigour and viability during subsequent storage under different temperature and RH (Dharmalingam and Basu, 1990).

Palanisamy and Karivaratharaju, (1992) reported that soaking of tomato seeds with dilute solution of disodium phosphate (10^{-4} M) or sodium chloride (10^{-3} M) greatly reduced further deterioration under natural condition and recorded increased germination and vigour.

Thornton and Powell (1992) reported that hydration -dehyration treatment given to accelaratedly aged seeds of brussels sprout cv. Asmer and cauliflower cv. Asmer and cauliflower cv. Hipop showed greater germination rate and seedling growth.

Penaloza and Eira (1993) reported that hydration - dehydration treatments with accelaratedly aged tomato seeds (42 C, 100% RH for 72 hr) showed improved germination and vigour.

Hydration-dehydration treatment on productivity

Tomato seeds treated with dilute solutions of sodium chloride (10^{-3} M) or sodium phosphate (dibasic 10^{-4} M) proved better for field performance and productivity (Mitra, 1979).

Kundu and Basu (1981) reported the beneficial effects of hydration -dehydration treatment to carrot seed with sodium thiosulphate (10^{-5} M) and disodium phosphate (10^{-4} M) for 2 hr on field performance and the roots from treated seeds were bigger than control. Bandopadhyay et al., (1982) reported that soaking and drying of Jute seeds for 1 hr showed significant beneficial effects on yield per plant and total yield per hectare.

Doijode (1987) reported that hydration -dehydration of vegetable seeds resulted in better establishment of seedlings. Among them onion seeds responded more for hydration -dehydration treatment than large sized seeds (garden pea).

Hore et al. (1988) reported that seed treatment with GA at 100 ppm significantly increased the fresh weight, dry weight of bulbs and leaf dry weight in onion cv.Red globe. Dharmalingam and Basu (1989) reported that 12 month - old mungbean seeds given invigoration treatment with tannic acid (2×10^{-5} M to 2×10^{-4} M) resulted in higher yield and dry matter production.

Materials & Methods

CHAPTER III

MATERIALS AND METHODS

The materials along with the methodology described in this chapter pertain to the studies on the seed technological aspects of bellary and aggregatum onion carried out at the Department of Seed Technology, Tamil Nadu Agricultural University, Coimbatore during 1992-93.

Bellary onion seeds were purchased from M/s.Sundarappa gounder, a seed merchant at Pollachi, Coimbatore district and that of aggregatum onion from a seed grower at Mandamedu, South Arcot district. Both the seeds were relatively fresh although, the exact date of harvest was not known; it would be approximately two months after harvest.

I. Standardisation of sieve size for grading

The bulk seeds were size graded using ISS 170, ISS 140 and ISS 120 (ISS - International standard sieve) wire mesh sieves. The seeds retained in each one of the sieves designated as S_1, S_2 and S_3, respectively were seperately collected, weighed and expressed as recovery percentage. The graded seeds were evaluated for seed quality using the following response parameters.

1. 100 Seed weight
2. Standard germination test

2a. Modified roll-towel method (MRT)

3. Seedling growth measurements such as root and shoot length.

4. Dry matter production (DMP)

5. Vigour Index (VI)

6. Electrical conductivity of seed leachate (EC)

1. 100 Seed weight

The 100 seed weight in respect to each size grade was determined as per ISTA (International Seed Testing Association, 1985) procedure using 8 x 100 seeds and the mean expressed in mg.

2. Standard germination test

The germination test was conducted as per ISTA rules (Anon, 1985) using roll towel method. Four replicates of 100 seeds were used and the test carried out at 25 ± 2° C and 90 ± 5 per cent RH maintained in a germination room illuminated with fluorescent light. After 12 days the germination test was evaluated and the normal seedlings with 'bent knee' were expressed as germination percentage.

2a. Modified roll towel method (MRT) (Dharmalingam, 1988)

For the growth measurements the seeds were germinated in modified roll-towel (MRT) method described by Dharmalingam (1988). The replicates of 25 seeds each were used in respect to each size grade. The germination conditions adopted for standard germination test was followed here also.

3. Grwoth measurements

Ten normal seedlings from MRT method were taken at random for measurement. The length of root and shoot of individual seedlings was measured seperately and mean value expressed in cm.

4. Dry matter production (DMP)

The seedlings used for growth measurements were taken in butter paper covers shade dried initially and subsequently dried in a hot air oven previously heated and maintained at $85 \pm 1^{\circ}C$ for 24 hr. The mean dry weight of seedlings was recorded in mg.

5. Vigour index (VI)

The vigour index was computed using the procedure of Abdul-Baki and Anderson (1973) with certain modifications as shown below and expressed as whole number.

II. VI = Germination (%) x Total seedling length (cm)

I. VI = Germination (%) x Drymatter production (mg)

6. Electrical conductivity

100 seeds taken at random were rinsed with deionised water and soaked in 100 ml of deionised water for 16 hr at room temperature (25 ± 3°C). The seed-steep water was deconded and referred to as seed leachate. The electrical conductivity of the seed leachate was measured in an Digital Conductivity meter and expressed as μ.mhos cm^{-1} (Presley, 1958).

II. Effect of seed size on storability

Two seed size classes namely, large (S_1) and small (S_2) (ISS 170 and ISS 140) dried to 8 per cent moisture content, and dry dressed with Thiram (2g/kg) were packed in cloth bags (C_1) and 700 gauge polyethylene bags (C_2) stored under ambient conditions of temperature and relative humidity along with the untreated counterpart. The seed samples were drawn at monthly interval and evaluated using the following response parameters.

1. Moisture content of the seed
2. Standard germination test.
3. Seedling growth measurements
4. Dry matter production
5. Vigour index

1. Moisture content of the seed

A weighed quantity of the seeds were taken in weighing bottles and heated in a hot air oven maintained at 105 ± 1°C for 16 ± 1hr. After drying the bottles were taken out and cooled in desiccator for 30 minutes. The moisture content was calculated using the following formula (ISTA, 1985).

$$\text{Moisture content} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where, M_1 = Weight of container and its cover.

M_2 = Weight of container with its cover and the content before drying and,

M_3 = Weight of container, with its cover and contents after drying.

III. Effect of Relative humidity on seed deterioration

The desired relative humidity conditions were achieved by using KOH solution of different concentrations as detailed below on standard recommendations (Solomon, 1951).

S.No.	KOH (g/100ml)	Relative humidity (%)
1.	0	100
2.	11.75	90
3.	22.25	75
4.	33.70	50

The respective grade of solution for maintaining the desired relative humidity was taken at the bottom of the desiccator and closed air-tight. Approximately 10 g seeds taken in cloth bag were placed on the wire guage kept at the brim of the desiccator. Precaution was taken to avoid direct contact of seeds with the solution. The assembly after making air tight was kept at room temperature. The seed samples were drawn at weekly intervals (W_1 to W_5) and seed quality evoluvated using the following parameters.

1. Standard germination test
2. Seedling growth measurements
3. Dry matter production
4. Vigour index
5. Electrical conductivity

IV. To study the senescene pattern under accelerated ageing condition by employing staining technique

Size graded (ISS 170) Bellary onion seeds were accelerately aged at 100 per cent RH and 40 C for 10 days (D_1 to D_{10}). For this seeds were first placed in small perforated paper packet and arranged loosely inside a desiccator. To maintain 100 per cent RH, water was taken at the bottom of the desiccator and closed tightly with the lid.

For maintaining 40 °C constant temperature the desiccator with seed packets was kept inside a B.O.D. incubator set at 40 °C. Seed packets were rearranged everyday at a fixed time to facilitate uniform ageing. At one day interval of ageing the staining pattern of the embryo was studied by tetrazolium staining technique (ISTA, 1985).

Tetrozolium test

The seeds were first pre conditioned by soaking in water over night. The embryo was then seperated following preconditioning. After removing the seed coat by cutting so as to expose embryo. Care was taken not to injure the embryo while removing the seed coat. The embryos were immersed in tetrazolium solution (0.5%) and kept at 40 °C for one hour in dark. Embryos were washed well with water and the staining pattern of the embryo studied. In addition, after each interval of ageing seeds were evaluated for the following response parameters.

1. Standard germination test
2. Seedling growth measurement
3. Dry matter production
4. Vigour Index method I, II

V. Control of seed deterioration by hydration-dehydration treatment

Processed seeds (ISS 170) of 2 months old bellary and aggregatum onion were given hydration-dehydration treatment by soaking in dilute solution of Disodium phosphate (10^{-4} M) for two and half hr followed by drying back to their original moisture content. Control seeds were not soaked but dried along with the hydrated seeds. The control and treated seeds after evaluvating their quality were packed in paper bag and stored under ambient conditions. Subsequent analysis for seed quality were made at monthly interval (P_1 to P_5) using the following parameters.

1. Standard germination
2. Seedling growth measurement
3. Drymatter production
4. Vigour index

VI. Effect of hydration -dehydration treatment on crop productivity

Processed seeds (ISS 170) of bellary and aggregatum onions were given hydration - dehydration treatment on 5^{th}, 6^{th} and 7^{th} (T1, T2 and T3) months after harvest of mother seeds and subsequently stored for 3, 2 and one month respectively, before sowing in the nursery for field planting. The plot size for yield trial adopted was 3.4 m^2

with ten ridges for each treatement and replicated thrice. The cultural practices recommended for the commercial crop were adopted. Observations on morphometric trait, such as plant height and the bulb yield were recorded in each treatment after harvest of crop.

The data were analysed statistically for interpreting the treatment effects.

Experimental Results

CHAPTER IV

RESULTS

I. Seed size studies

Bellary onion (Table. 1)

The results of seed recovery percentage of the Nasik red bellary onion seed lot used for the study constituted mostly of large seeds (ISS 170 retained) followed by the medium size ones (ISS 140 retained) to an extent of 82.0 and 14.0 per cent, respectively. The percentage of small seeds (ISS 120 retained) in the lot was however, very low (3.0 per cent). The seeds that passed through ISS 120 wire mesh sieve (1 per cent) comprised mostly of shrivelled, ill-filled and inert materials and hence eliminated from the study.

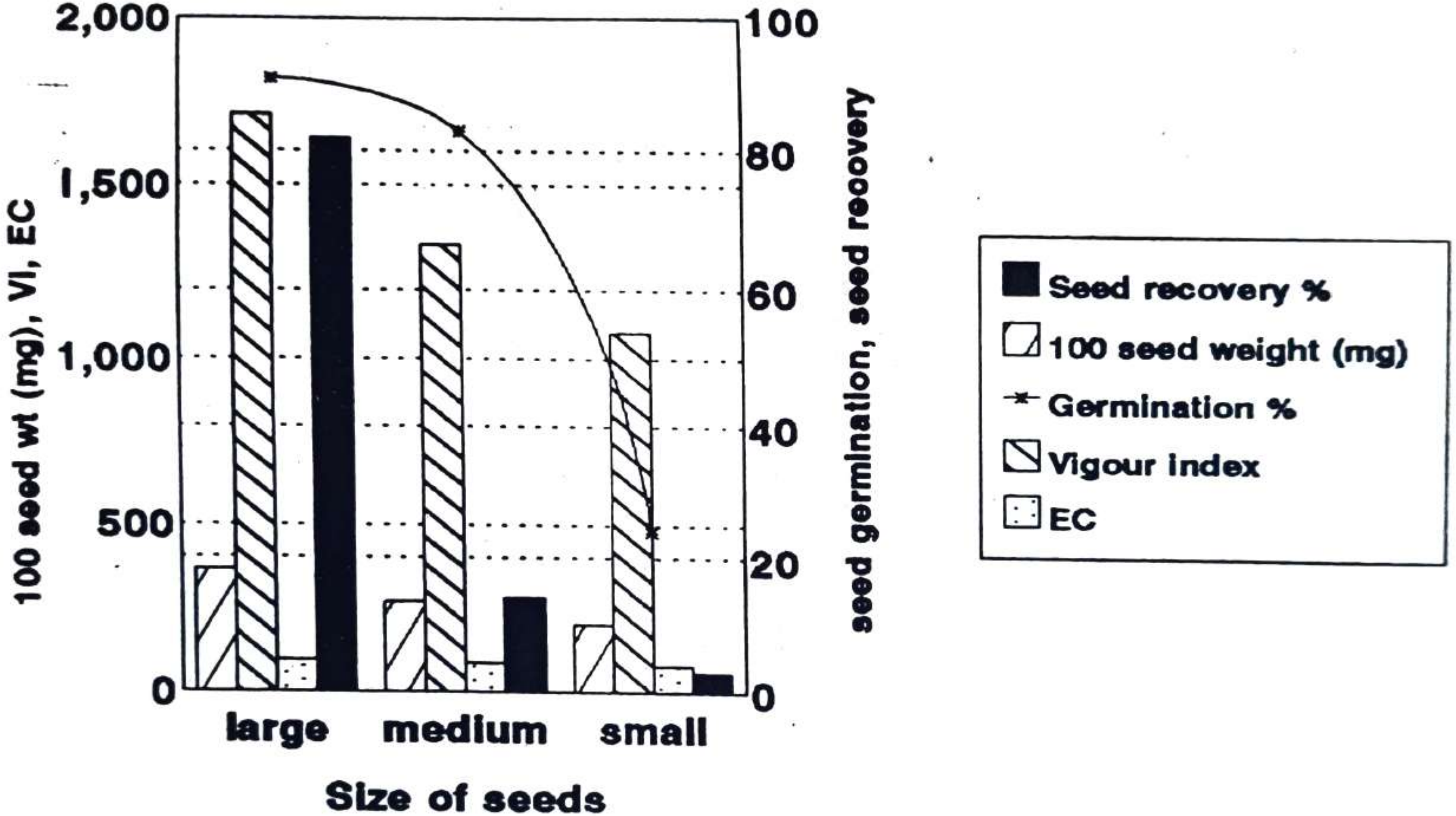
The 100 seed weight showed large and significant differences in respect to seed size classes. The differences in weight were 26.2 and 45.3 per cent between the large and medium and large and small seeds, respectively. Between the medium and small seeds, a difference of 25.8 per cent was seen, almost equal as that of the large and medium size seeds.

The germination percentage of seeds showed significant difference due to seed size. The germination percentage of large seeds was the highest (91 per cent) followed by those of the medium size seeds (83 per cent).

Table 1. Effect of seed size on seed quality in bellary onion cv. Nasik red

Parameters studied	Seed size grades (ISS) 170	140	120	Mean	CD(P=0.05)
Seed recovery(%)	82.0	14.0	3.0	-	-
100 seed weight(mg)	362.0	267.0	198.0	276	3.52
Germination(%)	91.0 (72.54)	83.0 (65.65)	24.0 (29.33)	66	5.34
Root length(cm)	6.9	6.4	5.7	6.3	0.34
Shoot length(cm)	9.8	9.5	8.3	9.2	0.34
Drymatter production seedlings 10^{-1} (mg)	19.0	16.0	13.0	16.0	1.75
Vigour index					
(i) (G % x DMP)	1710	1328	1078	1372	104.16
(ii) (G % x TSL)	1494	1338	954	1262	71.60
Electrical conductivity (u.mhos cm^{-1})	94.0	85.0	77.0	85.0	1.30

Fig1. Influence of size grades on quality of bellary onion cv. Nasik red



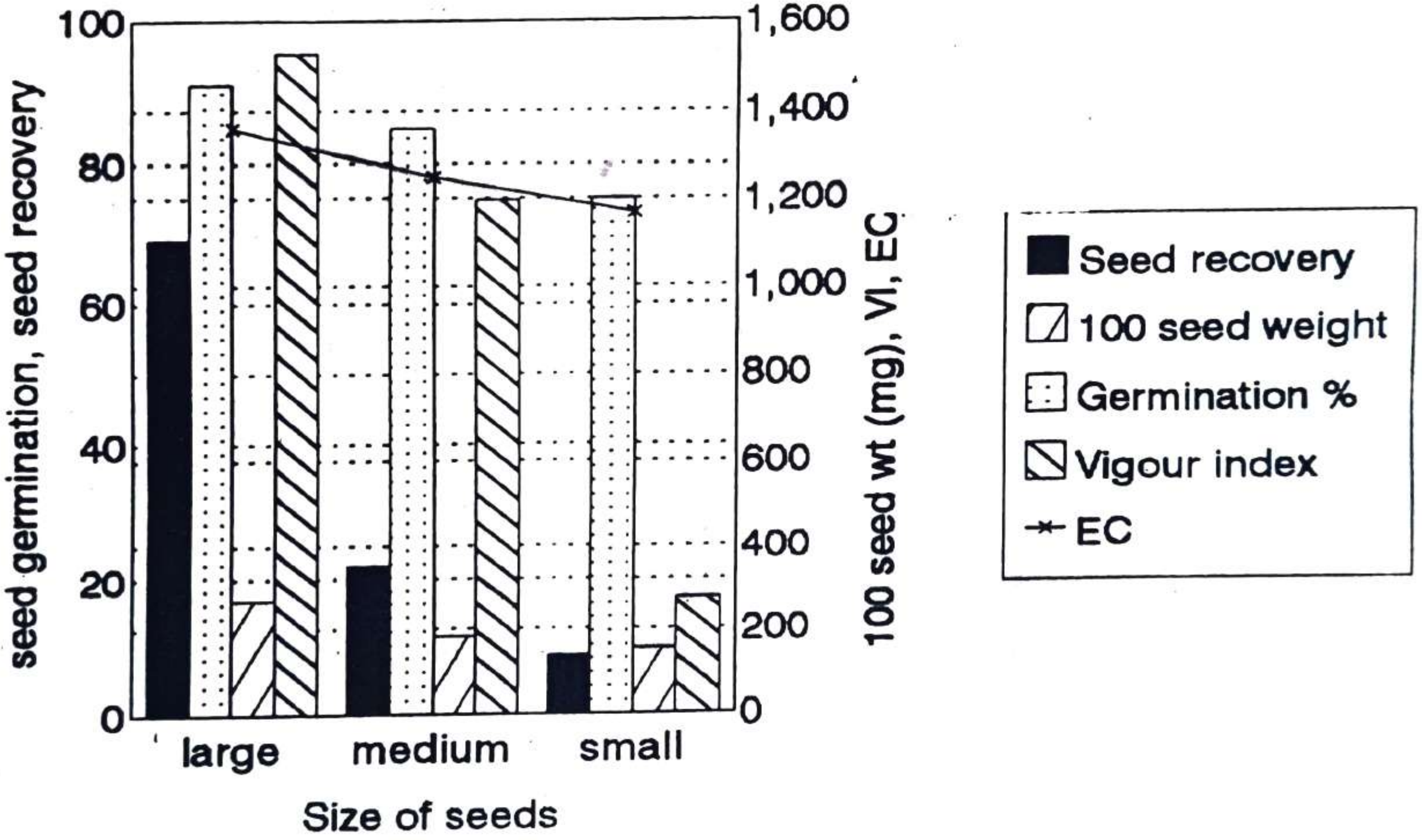
In both the cases, the level of germination was well above the seed standards prescribed. On the other hand, it was very low (24 per cent) in respect to small seeds ie., about 56 per cent below the standard prescribed.

The measurements of growth manifestations of 12 day - old seedlings raised from the seeds of different size grades all showed significant and positive results registering high values for large seeds followed by the medium size seeds and lowest for small size seeds. The percentage increase noticed in respect to root length was 7.3 and 11.0 per cent between the large to medium and medium to small seeds, respectively. In the case of shoot length, the difference between the large and medium was very meagre (about 3.0 per cent) but, between the medium and small however, was great (12.7 per cent).

The dry matter production of seedlings showed parallel results as that of root length. The differences obtained were 15.8 and 18.8 per cent between the large to medium and medium to small seed, respectively.

The vigour index values showed significant differences among seed size classes, irrespective of computation methods. Germination (%) x DMP registered higher values than germination(%) x Total seedling length. The differences obtained in the former method was 30.5 and

Fig2. **Influence of size grades on seed quality in Aggregatum onion cv. Mutlur local**



28.6 per cent between the large to medium and medium to small seeds, respectively; between the large to small seed it was 36.1 per cent. In the latter method (Germination (%) x Total seedling length), it was 23.3 and 18.8 per cent between the large to medium and medium to smal seed respectively; between large and small seed it was, 36.9 per cent.

Electrical conductivity of the seed leachate showed significant difference in respect to seed size. The difference was 9.5 and 9.4 per cent, respectively between the large to medium and medium to small seed.

Aggregatum onion (Table. 2)

The results of seed recovery percentage of the Mutlur local type aggregatum onion seed lot used for the study revealed that it contained about 69 per cent of large seed (ISS 170 retained), about 22 per cent of medium size (ISS 140 retained) seeds. Unlike the bellary onion, the medium and small sized seeds together constituted about 30 per cent of the total as against 17 per cent in bellary onion seed lot. The seeds that passed through ISS 120 wire mesh sieve (0.5 per cent) comprised mostly shrivelled, ill-filled and inert materials and hence eliminated from the study.

Table 2. Effect of seed size on seed quality in Aggregatum onion Cv. Mutlur local

Parameters studied	Seed size grades (ISS) 170	140	120	Mean	CD(P=0.05)
Seed recovery(%)	69.0	22.0	8.5	-	-
100 seed weight(mg)	267.0	182.0	153.0	201	7.18
Germination(%)	91.0 (72.50)	85.0 (67.20)	75.0 (60.00)	84	2.10
Root length(cm)	5.8	5.2	4.3	5.1	0.31
Shoot length(cm)	8.6	6.0	4.1	6.2	0.81
Drymatter production seedlings 10^{-1} (mg)	17.0	14.0	11.0	14.0	1.16
Vigour index					
(i) (G % x DMP)	1526	1196	274	999	81.13
(ii) (G % x TSL)	1191	889	181	754	55.86
Electrical conductivity (u.mhos cm^{-1})	85.0	78.0	73.0	79.0	0.95

The 100 seed weight showed large and significant difference in respect to seed size classes. The difference in weight were 31.8 and 42.6 per cent between the large to medium and large to small seeds, respectively. Between the medium and small seeds the difference was 15.9 per cent.

The germination percentage of seeds showed significant differences due to seed size. The germination percentage of large seeds was the highest (91 per cent) followed by those of the medium size seeds (85 per cent). The small seeds of aggregatum onion showed fairly high germination (75 per cent) in contrast to small seeds of bellary onion (24 per cent).

The growth measurements of 12 day - old seedlings raised from the seeds of different size grades showed significant and positive results. High values were registered for large seeds followed by the medium size seeds and lowest for small size seeds. The percentage increase noticed in respect to root length was 10.4 and 17.3 per cent between the large to meidum and medium to small seeds, respectively.

In the case of shoot length, the difference between the large and medium was 30 per cent. But between the medium to small was 31 per cent.

The dry matter production of seedlings showed significant differences in respect to seed size. The difference was 17.8 and 21.4 per cent between large to medium and medium to small seeds respectively.

The vigour index computed from germination percentage and total drymatter production as well as from germination percentage and total seedling length, showed significant differences between the seed size classes. The former gave higher values for all seed size grades than the latter. The difference noticed in the former was 25.3 and 79.6 per cent between the large to medium and medium to small seeds, and 21.6 and 77.0 per cent, respectively in the latter case.

Electrical conductivity of the seed steep water showed significant results where the differences were 8.2 per cent and 6.4 per cent between the large to medium and medium to small seeds, respectively.

Seed storage studies

The storage studies carried out for eight months under ambient conditions with the seeds of Bellary and aggregtum onion of two size grades (ISS170 and ISS140) following seed treatments with thiram and packed in cloth bag and 700 gauge polyethylene containers exhibited significant differences in seed quality.

Table 3. Effect of seed size, seed treatment and containers on moisture content (%) of Bellary Onion cv. Nasik red under ambient storage conditions

TREAT MENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	8.0	8.1	13.8	10.2	12.8	14.1	15.2	15.6	16.2	8.0	8.0	10.6	10.4	10.2	10.1	10.7	10.1	10.3	11.6	11.5
S2	8.0	8.2	13.6	14.2	12.8	14.2	15.1	15.5	16.1	8.0	8.0	10.6	10.2	10.1	10.0	10.7	10.3	10.2		
T1 S1	8.0	8.8	15.0	14.4	12.9	15.1	14.8	17.1	15.5	8.0	8.3	10.8	11.2	10.6	11.8	10.4	10.3	10.7	11.3	11.4
S2	8.0	8.8	13.9	13.1	13.2	14.2	13.3	11.0	14.1	8.0	8.2	11.0	12.0	9.8	10.1	9.8	12.0	11.0		
C2 Mean	8.0	8.5	14.1	13.9	12.9	14.4	14.6	14.6	15.4	8.0	8.1	10.7	10.9	10.2	10.5	10.4	10.6	10.5	-	-
C Mean					12.9										10.0					
P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2		
	8.0		8.3		12.4		12.4		11.5		12.5		12.5		12.6		13.0			

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.09	0.09	0.09	0.20	0.13	0.13	0.28	0.13	0.28	0.28	0.19	0.40	0.40	0.40	0.57

Table 4. Effect of seed size, seed treatment and containers on Germination (%) of Bellary Onion cv. Nasik red under ambient storage conditions

TREATMENT		C1									C2									S Mean	T Mean
		P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0	S1	87 (68.9)	82 (64.9)	80 (63.0)	68 (55.5)	62 (51.9)	53 (46.7)	42 (40.3)	33 (35.0)	32 (34.4)	87 (68.9)	81 (64.2)	83 (65.6)	78 (62.0)	69 (56.1)	68 (55.5)	43 (40.6)	56 (48.2)	53 (46.7)	50.4	62 (52.1)
	S2	83 (65.6)	72 (58.1)	72 (53.1)	54 (47.2)	58 (49.6)	58 (49.6)	40 (39.1)	33 (35.0)	21 (27.9)	83 (65.6)	73 (58.7)	69 (56.8)	63 (52.5)	60 (50.7)	61 (51.3)	53 (46.7)	45 (42.1)	39 (38.4)		
T1	S1	87 (68.9)	82 (64.4)	79 (62.7)	70 (56.6)	72 (58.0)	66 (54.3)	49 (44.4)	48 (43.8)	44 (41.5)	87 (68.9)	84 (66.7)	82 (63.7)	78 (62.7)	77 (61.6)	75 (60.0)	72 (58.0)	72 (58.0)	68 (55.5)	56.6	67 (54.9)
	S2	83 (65.6)	73 (58.7)	71 (57.4)	65 (53.7)	62 (51.9)	60 (50.7)	42 (40.3)	36 (36.8)	25 (29.9)	83 (65.6)	76 (60.6)	73 (58.7)	68 (55.5)	65 (53.7)	66 (54.3)	55 (47.8)	48 (43.8)	41 (39.8)		
C1 C2 Mean		85 (67.3)	77 (61.5)	74 (59.0)	64 (53.3)	63 (52.9)	59 (50.3)	44 (41.0)	37 (37.6)	30 (33.4)	85 (67.3)	78 (62.5)	77 (61.2)	72 (58.2)	68 (55.5)	63 (53.3)	64 (53.3)	55 (48.0)	50 (45.1)	-	-
C Mean						50.7									56.3						

P Mean	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2
	85 (67.3)	78 (62.0)	75 (60.1)	66 (55.7)	66 (54.2)	63 52.8	54 (47.2)	46 (42.8)	40 (39.3)

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.59	0.59	1.25	1.25	0.83	0.83	1.77	0.83	1.77	1.77	1.18	2.50	2.50	2.50	3.50

Bellary

Seed moisture content (Table. 3)

The initial moisture content of seeds at packing both in the cloth bag (C_1) and polyethylene bag (C_2) was 8.0 per cent upon storage for 8 months. The seed moisture had increased to an extent of 4.9 per cent in respect to the seeds in C_1 and 2.0 per cent those in C_2. In both the cases, the quantum jump was high. Between containers, the seeds in cloth bag registered more moisture than those in polyethylene bag . Between seed sizes, the large size seeds (ISS170) absorbed more moisture 3.6 per cent than the small sized (ISS140) seeds (3.3 per cent). The seeds treated with thiram (T_1) had significantly lower mean moisture content (11.4 per cent) when compared to the control (T_0) seeds (11.5 per cent). However, the difference between them was only 0.1 per cent. As the period of storage advanced, there was consistent gain in seed moisture content irrespective of treatments and size of seeds. In control seeds, the moisture content increased from 8.0 to 16.2 per cent where the large sized seeds had higher moisture than the small seeds.

Germination percentage (Table. 4)

The initial germination of seeds was 87 and 83 per cent for the large and small sized seeds, respectively. The seeds stored in C_1 suffered more loss than those stored

Table 5. Effect of seed size, seed treatment and containers on Root Length(cm) of Bellary Onion cv. Nasik red under ambient storage conditions

TREATMENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	6.4	5.1	5.2	4.1	3.4	3.8	4.5	3.5	2.7	6.4	6.0	5.3	4.2	3.7	4.0	4.6	4.0	3.4		
S2	4.7	5.1	5.0	4.0	3.2	3.8	4.1	2.9	2.2	4.7	5.6	5.0	4.2	3.4	4.0	4.4	4.3	3.0	4.3	4.3
T1 S1	6.4	6.3	5.6	3.7	3.8	4.4	4.4	3.5	3.3	6.4	6.4	6.3	4.8	4.6	5.3	4.7	3.9	3.8		
S2	5.7	4.7	3.2	3.5	4.3	4.3	3.3	3.3	2.9	5.7	5.6	4.4	3.6	4.5	4.5	3.5	3.5	3.5	4.6	4.6
C2 Mean	5.9	5.5	5.1	3.8	3.4	4.1	4.3	3.3	2.8	6.0	5.9	5.5	4.4	3.8	4.4	4.5	3.9	3.4		
C Mean					4.2										4.7					
P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2		
	6.0		5.7		5.3		4.1		3.6		4.2		4.4		3.6		3.1			

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.068	0.068	0.068	0.140	0.095	0.095	0.200	0.095	0.200	0.200	0.130	0.280	0.280	0.280	0.400

in C_2 to an extent of about 6 per cent. The untreated large seeds stored in C_1 and C_2 showed a biological loss of 63.2 and 39 per cent, respectively.

The overall results revealed the superiority of C_2 over C_1 and T_1 over T_0. As the period of storage advanced, the germination reduced from 85 to 40 per cent.

Root length (Table. 5)

The differences in mean root length were significant due to seed size, treatment, container and period of stroage. The reduction in root length was more in untreated seeds stored in cloth bag suffered a biological loss of 56.4 and 46.5 per cent in S_1 and S_2, respectively. The corresponding reduction noticed in the counterpart seeds stored in C_2 was 45.1 and 30.2 per cent, respectively. In the case of treated seeds, the biological loss occurred was 41.9 per cent and 25.5 per cent in respect to C_2 and 48.3 per cent and 39.5 per cent in respect to C_1 for S_1 and S_2, respectively.

The analysis of variance brought out the overall superiority of S_1 (4.3 cm) over S_2 (3.8 cm); the C_2 (4.2 cm) over C_1 (3.9 cm) and T_1 (4.1 cm) over T_0 (4.0 cm).

Table 6. Effect of seed size, seed treatment and containers on Shoot Length(cm) of Bellary Onion cv. Nasik red under ambient storage conditions

TREAT MENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	9.7	8.9	9.4	8.4	7.1	7.2	6.9	6.9	5.5	9.7	9.2	9.5	8.6	7.7	7.3	7.1	6.8	5.8	6.6	6.6
S2	7.2	6.8	6.6	5.0	4.1	4.3	4.7	4.4	5.2	7.2	7.2	6.6	5.0	4.5	4.7	4.8	4.6	5.7		
T1 S1	9.7	9.1	9.2	8.2	7.1	7.4	7.3	7.1	6.5	9.7	9.8	9.4	8.5	7.4	7.4	7.8	7.4	6.8	6.8	6.8
S2	7.2	6.7	6.9	5.2	4.3	4.5	4.4	4.6	5.0	7.2	7.3	7.6	5.2	4.4	4.8	4.9	4.7	5.4		
C1 C2 Mean	8.4	7.9	8.0	6.7	5.6	5.8	5.8	5.7	5.5	8.4	8.3	8.2	6.8	6.0	6.0	6.1	5.8	5.9	-	-
C Mean					6.6										6.8					

P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	8.4		8.1		8.1		6.8		5.8		5.9		6.0		5.7		5.7	

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.11	0.11	0.11	0.24	0.16	0.16	0.34	0.16	0.34	0.34	0.23	0.49	0.49	0.49	0.69

Table 7. Effect of seed size, seed treatment and containers on Dry matter Production (mg) of Bellary Onion cv. Nasik red under ambient storage conditions

TREAT MENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	18	14	14	14	15	13	13	12	13	18	16	15	14	16	14	15	13	15	15	12
S2	16	14	12	10	11	10	10	10	10	16	16	13	13	11	11	12	11	10		
T1 S1	18	18	17	16	16	15	14	15	14	18	20	17	18	17	17	16	15	16	16	13
S2	16	14	12	12	12	12	13	11	11	16	15	12	14	14	12	14	12	13		
C1 C2 Mean	16	15	13	13	13	12	12	12	12	17	16	14	14	15	13	14	12	13	-	-
C Mean						14									15					

P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	16		16		14		14		14		13		13		12		12	

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.03	0.03	0.03	0.07	0.04	0.04	0.10	0.014	0.10	0.10	0.07	0.14	0.14	0.14	0.20

Shoot length (Table. 6)

The mean differences in shoot length of seedlings were significant in respect to all treatments. The maximum biological loss occurred in untreated seeds which were stored in cloth bag to an extent of 43.2 and 27.7 per cent, in S_1 and S_2. The corresponding reduction noticed in the counter part seeds was 40.2 and 20.8 per cent. The container C_1 was superior (6.8 cm) to C_2 (6.6 cm); The treated seeds (6.8 cm) was significantly better than the control (6.6 cm). As the period of storage advanced, the shoot length reduced significantly from 8.4 cm (P_0) to 5.7 cm (P_8).

Dry matter production (Table. 7)

The dry matter production of seedlings differed significantly in all the treatments. The maximum biological loss was with untreated seeds stored in C_1 to extent of 27.7 and 37.5 per cent, respectively for S_1 and S_2. In contrast, the counterpart seeds stored in C_2 suffered in the range of 16.6 and 37.5 per cent. On the other hand, the biological loss occurred in treated seeds was in the order of 22.2 and 31.5 per cent for C_1 and 11.1 and 18.7 per cent for C_2 in respect to S_1 and S_2 seeds.

The results revealed the superiority of large sized seeds (15 mg) over small sized ones (13 mg). Between the

Table 8. Effect of seed size, seed treatment and containers on the Vigour Index I (G% x DMP) of Bellary Onion cv. Nasik red under ambient storage conditions

TREAT MENT	C1									C2										
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8	S Mean	T Mean
T0 S1	1566	1148	1120	952	930	689	546	396	416	1566	1296	1245	1092	1104	952	645	728	689		
S2	1328	1008	864	540	638	580	400	330	210	1328	1168	897	819	660	621	636	495	390	770	804
T1 S1	1566	1476	1343	1120	1152	990	686	720	616	1566	1680	1394	1404	1309	1275	1152	1080	1088		
S2	1328	1022	852	750	744	720	546	396	275	1328	1140	876	952	910	792	770	576	533	1100	808
C1 C2 Mean	1360	1155	962	832	819	708	528	444	360	1445	1248	1078	1008	1020	819	896	660	650		
C Mean	842									1028										

P Mean	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2
	1360	1248	1050	924	924	819	702	552	480

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	2.8	2.8	2.8	6.0	4.0	4.0	8.5	4.0	8.5	8.5	5.7	12.0	12.0	12.0	17.1

Table 9. Effect of seed size, seed treatment and containers on the Vigour Index II (G% x TSL) of Bellary Onion cv. Nasik red under ambient storage conditions

TREAT MENT		C1									C2									S Mean	T Mean
		P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0	S1	1179	836	827	621	529	453	452	409	336	1179	991	957	735	695	557	540	530	456	492	615
	S2	793	612	520	450	412	396	310	236	137	793	641	529	536	478	482	435	364	318		
T1	S1	1179	1047	822	645	552	511	515	423	375	1179	1105	1011	746	725	607	562	539	529	764	639
	S2	793	656	604	515	420	401	369	284	194	793	704	607	616	481	451	462	452	297		
C1 C2 Mean		993	826	693	658	478	440	411	338	261	1006	821	776	658	595	524	476	471	400		
C Mean						556									700						

P Mean C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
1000		824		734		608		536		482		726		405		330	

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	11.3	11.3	11.3	24.1	16.0	16.0	34.1	16.0	34.1	34.1	22.7	48.2	48.2	48.2	68.2

containers, C_2 (15 mg) was superior to C_1 (14 mg). The seeds treated with thiram was better than the control by registering an overall mean of 13 and 12 mg, respectively. The reduction in DMP was significant at different storage periods with a fall from 16 to 12 mg (P_0 to P_8).

Vigour index I (G.% x DMP) (Table. 8)

The computed vigour index revealed significant differences where the untreated seeds stored in C_1 undergone maximum biological loss (73.4 and 84.1 per cent) in S_1 and S_2 as against 56.0 and 70.6 per cent for the counter part seeds in C_2. For treated seeds, the corresponding values were 60.6 and 77.7 per cent in respect to C_1 30.5 and 59.8 per cent for C_2, in the case of S_1 and S_2 seeds.

The analysis of variance revealed the superiority of S_1 (1102) over S_2 (770); C_2 (1028) over to C_1 (842); and T_1 (808) over T_0 (804). As the period of storage advanced, the Vigour Index reduced significantly from 1360 (P_0) to 480 (P_8).

Vigour Index II (G% x TSL) (Table. 9)

The results obtained were parallel to that of the previous computation except for the differences in the numerical values.

Table 10. Effect of seed size, seed treatment and containers on Moisture Content (%) of Aggrecatum Onion cv. Mutlur local under ambient storage conditions

TREAT MENT	C1									C2									S	T
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8	Mean	Mean
T0 S1	8.4	8.9	14.0	13.2	14.1	14.0	14.5	17.4	17.5	8.4	8.6	10.7	11.2	10.4	12.0	10.5	11.3	11.4		
S2	8.4	8.6	13.0	12.1	12.0	14.2	14.4	17.1	17.1	8.4	8.4	10.0	10.2	10.0	12.0	10.1	11.2	11.3		
T1 S1	8.4	8.2	12.3	13.1	13.4	13.6	14.6	15.0	17.5	8.4	8.4	10.4	10.1	10.3	9.6	10.4	10.0	11.3		
S2	8.4	8.4	12.6	12.4	10.2	13.6	14.4	15.0	17.1	8.4	8.3	10.3	10.1	10.0	9.6	10.2	10.1	10.1		
C1 C2 Mean	8.4	8.5	13.0	12.7	12.4	13.8	14.5	16.1	16.3	8.4	8.4	10.3	10.4	10.2	10.8	10.3	10.6	10.7		
C Mean						12.8										11.3				
P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2		
	8.4		8.5		11.6		11.5		11.3		12.3		12.4		13.4		13.4			

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.02	0.02	0.02	0.06	0.041	0.041	0.08	0.04	0.08	0.08	0.05	0.12	0.12	0.12	0.17

Table 11. Effect of seed size, seed treatment and containers on Germination (%) of Aggregatum Onion cv. Mutlur local under ambient storage conditions

TREATMENT	C1 P0	C1 P1	C1 P2	C1 P3	C1 P4	C1 P5	C1 P6	C1 P7	C1 P8	C2 P0	C2 P1	C2 P2	C2 P3	C2 P4	C2 P5	C2 P6	C2 P7	C2 P8	S Mean	T Mean
T0 S1	84 (66.4)	76 (58.7)	63 (52.5)	62 (51.7)	58 (49.6)	53 (46.7)	50 45.0	47 43.2	41 (39.7)	84 (66.4)	76 (60.6)	72 58.0	72 (58.0)	68 (55.5)	65 (53.7)	63 (52.5)	60 (50.7)	53 (46.7)		
S2	74 (59.3)	62 (51.75)	61 (51.3)	55 (47.8)	50 (45.0)	46 (42.8)	40 (39.2)	31 (33.8)	19 (25.7)	74 (59.3)	63 (52.5)	60 50.7	57 (49.0)	53 (46.7)	51 (45.5)	47 (43.2)	46 (42.7)	37 (37.4)	53 (46.9)	58 (49.8)
T1 S1	84 (66.4)	76 (60.7)	66 (54.3)	63 (52.5)	60 (50.7)	56 (48.4)	53 (46.7)	50 (45.0)	43 (40.9)	84 (66.4)	79 (62.7)	75 60.0	74 (59.4)	71 (57.4)	67 (54.9)	65 (53.7)	62 (51.9)	56 (48.4)		
S2	74 (59.3)	63 (52.5)	62 (51.9)	58 (49.6)	53 (46.7)	51 45.5	43 (40.9)	34 (35.6)	23 (28.6)	74 (59.3)	66 (54.3)	63 52.5	60 (50.7)	56 (48.4)	52 (46.3)	50 (45.0)	49 (44.4)	41 (39.8)	65 (53.8)	60 (50.9)
C1 C2 Mean	79 (62.9)	63 (52.5)	62 (51.6)	57 (49.3)	53 (46.7)	50 (45.0)	45 (42.1)	40 (39.1)	29 (32.9)	84 (66.4)	76 (60.7)	69 (56.2)	68 (55.4)	64 (53.3)	60 (50.9)	58 (49.5)	55 (47.7)	43 (43.9)		
C Mean	56 (48.1)									62 (52.5)										

P Mean	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2
	82 (64.6)	70 (56.7)	65 (53.9)	63 (52.3)	59 (50.0)	56 (48.0)	51 (45.8)	47 (43.4)	39 (38.4)

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.57	0.57	0.57	1.21	0.81	0.81	0.71	0.81	1.71	1.71	1.14	2.43	2.43	2.43	3.43

Aggregatum onion

Moisture content (Table. 10)

The initial moisture content of seeds at packing was about 8.4 per cent. Following storage for 8 months, the seeds gained moisture to an extent of 3.3 per cent in respect to seeds in C_2 and 4.8 per cent in C_1.

The seeds stored in polyethylene gained moisture upto 11.3 per cent as against 12.8 per cent in those stored the cloth bag. The treated seeds had significantly lower moisture content (11.1 per cent) than the control. As the period of storage advanced, there was consistent gain in seed moisture content irrespective of treatments and containers.

The mean seed moisture gained by the large size seeds was more (11.6 per cent) than the small seeds (10.0 per cent).

Germination percentage (Table. 11)

The initial germination of seeds was high, 84 per cent and 74 per cent for the large and small seeds, respectively. The untreated seeds stored in C_2 and C_1 showed a biological loss of 36.9 and 51.1 per cent and 50 and 74 per cent for S_1 and S_2 seeds, respectively. In contrast, the biological loss underwent in treated seeds

Table 12. Effect of seed size, seed treatment and containers on Root length (cm)of Aggregatum Onion cv. Mutlur local under ambient storage conditions

TREAT MENT		C1									C2									S Mean	T Mean
		P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0	S1	6.2	5.9	5.4	3.4	3.3	3.2	4.1	3.1	2.7	6.2	5.9	6.0	4.1	4.2	3.3	4.1	3.3	3.4	3.8	4.0
	S2	4.3	4.2	4.0	4.1	4.3	4.1	3.1	3.1	2.3	4.3	4.2	4.0	4.1	4.3	4.1	4.4	3.3	3.0		
T1	S1	6.2	6.2	5.1	3.4	3.4	3.7	4.3	3.3	3.2	6.2	6.0	6.0	4.2	4.3	3.4	3.4	3.4	3.6	4.4	4.1
	S2	4.3	4.4	4.1	3.3	3.2	3.5	3.2	3.0	2.6	4.3	4.4	4.1	4.0	3.7	3.7	4.4	3.6	3.2		
C1 C2 Mean		5.1	5.2	4.7	3.6	3.5	3.6	3.7	3.1	2.7	5.2	5.1	5.0	4.1	4.1	3.6	4.1	3.4	3.2	-	-
C Mean						3.9									4.2						

P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	5.1		5.1		4.8		3.8		3.8		3.6		3.9		3.2		2.9	

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.06	0.06	0.06	0.13	0.09	0.09	0.19	0.09	0.19	0.19	0.12	0.27	0.27	0.27	0.38

packed in C_2 was 33.3 and 44.5 per cent and in C_1 48.8 and 68.9 per cent, respectively for the large and small seeds.

The overall results revealed the superiority of C_2 over C_1 and T_1 over T_0. As the period of storage advanced, the germination reduced from 82 to 39 per cent.

Root length (Table. 12)

The differences in mean root length were significant due to seed size, treatments, containers and period of storage. The reduction in root length was more in untreated seeds stored in cloth bag and the biological loss was 62.6 and 47.5 per cent in S_1 and S_2, respectively. The corresponding values for the counterpart seeds stored in polyethylene bag were 46.2 and 32.2 per cent respectively. In the case of treated seeds the biological losses were 40.2 per cent and 24.2 per cent in respect to C_1 and 45.3 and 38.3 per cent in respect to C_2 for S_1 and S_2, respectively.

The overall results revealed the superiority of S_1 (4.2 cm) over S_2 (3.5 cm); C_2 (4.1 cm) over C_1 (3.5 cm) and T_1 (4.1 cm) over T_0 (4.0 cm). As the storage of period advanced, the root length got reduced significantly from 5.1 cm (P_0) to 3.2 cm (P_8).

Table 13. Effect of seed size, seed treatment and containers on shoot length (cm)of Aggregatum Onion cv. Mutlur local under ambient storage conditions

TREAT MENT		C1									C2									S	T
		P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8	Mean	Mean
T0	S1	7.9	7.6	7.6	6.6	5.8	5.2	4.9	5.5	5.4	7.9	7.7	7.3	6.1	5.9	5.5	6.4	5.7	5.5	5.3	5.7
	S2	6.5	6.0	5.5	5.5	4.7	4.5	4.4	5.3	4.2	6.5	6.2	5.5	6.2	4.9	4.8	4.8	5.6	6.1		
T1	S1	7.9	7.6	7.6	6.6	5.8	5.2	4.9	5.5	5.4	7.9	7.7	7.3	6.1	5.9	5.5	6.4	5.7	5.5	6.3	5.9
	S2	6.5	5.8	4.6	4.9	5.0	5.1	4.6	4.5	4.9	6.5	5.9	4.8	5.2	4.6	5.2	4.8	4.6	5.2		
C1 C2 Mean		7.0	6.7	6.2	5.9	5.3	5.0	4.8	5.1	5.4	7.0	6.9	6.2	5.8	5.3	5.3	5.3	5.3	5.7	-	-
C Mean							5.7								5.9						

P Mean	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2
	7.0	6.8	6.2	5.9	5.3	5.2	5.0	5.2	5.6

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.09	0.09	0.09	0.20	0.13	0.13	0.29	0.13	0.29	0.29	0.19	0.41	0.41	0.41	0.59

Table 14. Effect of seed size, seed treatment and containers on Drymatter Production (mg) of Aggregatum Onion cv. Mutlur local under ambient storage conditions

TREAT MENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	16	15	12	12	14	13	11	10	9.9	16	16	14	13	15	14	13	11	10		
S2	14	12	12	12	11	10	10	11	9.8	14	14	12	12	12	11	11	11	9.8	11	12
T1 S1	16	16	15	14	15	13	13	14	13	16	18	16	15	16	16	15	15	14		
S2	14	12	11	11	12	10	11	9.8	9.5	14	13	12	12	13	11	10	10	9.9	14	13
C1 C2 Mean	15	14	12	12	13	11	11	11	10	15	15	13	13	14	13	12	12	11		
C Mean	12									13										

P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
	14		14		13		12		13		12		12		11		10	

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	0.03	0.03	0.03	0.07	0.05	0.05	0.10	0.05	0.10	0.10	0.07	0.15	0.15	0.15	0.21

Shoot length (Table. 13)

The difference in shoot length of seedlings was significant in respect to all treatments. The maximum loss was suffered by untreated seeds of both the grades, stored in cloth bag to an extent of 31.6 and 35.3 per cent in S_1 and S_2. The corresponding reduction noticed in the counterpart seeds stored in polyethylene bag was 30.3 and 6.15 per cent in S_1 and S_2, respectively. Between the containers, (C_2) was superior (5.9 cm) to C_1 (5.7 cm). The treated (T_1) seeds registered higher shoot length (5.9 cm) than control 5.7 cm. As the period of storage advanced, the shoot length reduced significantly from 7.0 (P_0) to 5.6 cm (P_8).

Dry matter production (Table. 14)

The differences in dry matter production of seedlings was significant in all the treatments. The maximum biological loss occurred to untreated seeds stored in cloth bag, both the large and small seeds. The counterpart seeds stored in polyethylene bag showed a loss in the range of 37.5 and 30 per cent in S_1 and S_2. On the other hand, the loss occured in treated seeds was in the order of 18.7 and 32.1 for C_1 and 12.5, 29.2 per cent for C_2, respectively for S_1 and S_2 seeds.

Table 15. Effect of seed size, seed treatment and containers on Vigour Index I (G % x DMP) of Aggregatum Onion cv. Mutlur local under ambient storage conditions

TREAT MENT	C1									C2									S Mean	T Mean
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P0	P1	P2	P3	P4	P5	P6	P7	P8		
T0 S1	1168	991	827	621	529	453	452	409	336	1168	836	957	735	695	557	705	530	456	760	491
S2	891	612	520	450	412	396	310	236	137	891	641	529	536	478	482	435	364	318		
T1 S1	1168	1047	822	645	552	511	515	423	375	1168	1105	1011	746	725	607	562	539	529	1070	763
S2	891	656	604	515	420	401	369	284	194	891	704	607	616	481	451	462	452	297		
C1 C2 Mean	993	826	693	558	478	440	411	338	261	1006	821	776	658	595	524	526	47	400		
C Mean						536									653					
P Mean	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2		

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	2.5	2.5	2.5	5.8	3.8	3.8	8.0	3.6	8.0	8.0	5.5	10.0	10.0	10.0	15.1

Table 16. Effect of seed size, seed treatment and containers on Vigour Index II (G % x TSL) of Aggregatum Onion cv. Mutlur local under ambient storage condition

TREATMENT		C1 P0	C1 P1	C1 P2	C1 P3	C1 P4	C1 P5	C1 P6	C1 P7	C1 P8	C2 P0	C2 P1	C2 P2	C2 P3	C2 P4	C2 P5	C2 P6	C2 P7	C2 P8	S Mean	T Mean
T0	S1	1400	1176	1152	859	652	591	486	340	262	1400	1213	1226	1002	787	769	892	601	490	602	712
	S2	1015	860	724	493	394	473	355	244	166	1015	935	791	582	476	535	492	401	339		
T1	S1	1400	1272	1171	838	789	717	579	511	432	1400	1339	1265	1056	961	956	903	819	725	901	791
	S2	1015	893	822	650	487	532	387	287	201	1015	1001	967	660	525	612	518	396	365		
C1 C2 Mean		1223	1050	967	685	580	578	452	345	265	1223	1122	1062	825	687	718	701	554	479	-	-
C Mean							684								819						

P Mean	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2	C1 C2
	1226	1086	1015	755	634	648	576	450	372

	T	S	C	P	TS	TC	TP	SC	SP	CP	TSC	TSP	TCP	SCP	TSCP
CD=	16.3	16.3	16.3	34.7	23.1	23.1	49.1	23.1	49.1	49.1	32.7	69.5	69.5	69.5	98.3

The overall results revealed the superiority of large sized seeds (14 mg) over small sized seeds (11 mg); that of polyethylene (13 mg) over cloth bag (12 mg) and treated (13 mg) over the untreated ones (12 mg). The reduction in DMP was significantly different during P_0 to P_8 (14 mg to 10 mg).

Vigour index I & II (Table. 15 and 16)

The computed vigour index (I and II) showed significant differences, where the trend of results were parallel. By and large, the trend revealed the superiority of C_2 in both the treated and untreated seeds. Between treatments, the treated seeds registered higher VI values than the control. The large seeds had higher VI than the small seeds. As the period of storage advanced, the VI values decreased significantly irrespective of treatment, containers and seed size. In each case the numerical values showed small differences.

Effect of RH of the storage environment on seed quality in bellary onion

Moisture content (Table 17)

The moisture content of seeds stored under varied RH levels at ambient temperature showed significant differences between levels and period of storage as well as

Table 17. Effect of different RH levels on the moisture content(%) of bellary onion seeds under ambient storage temperature

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	8.0	8.0	8.0	8.0	8.0
W_1	20.2*	11.5	11.8	10.0	13.4
W_2	-	14.1	12.8	10.2	9.3
W_3	-	17.6	13.3	10.5	10.3
W_4	-	18.1	13.3	12.1	10.9
W_5	-	20.4	15.7	12.6	12.2
Mean	4.7	14.9	12.5	10.6	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.20
Between RH = 0.17
Between W x RH = 0.41

their intractions. The overall results revealed that with the increase in relative humidity levels, the seeds absorbed more moisture and thereby, the seed moisture content increased significantly. Similarly, as the period of storage increased, the seed moisture content increased significantly .

At each relative humidity level, the quantum increase as well as the rate of moisture absorbtion exhibited large variations. For example, under 100 per cent RH level, the quantum jump in moisture content was 12 per cent over a period of one week enhancing the seed moisture from 8 to 20.2 per cent. Since the seeds were completly infected by fungi further observations could not be recorded and the seeds discarded. On the other hand, under 90 per cent RH level the seeds took almost five weeks to reach that moisture level of 20.4 per cent. The rate of increase in imbibition was about 3.5 per cent over a period of one week which prevailed upto the following three weeks. Beyond that the rate absorbtion decreased to 1 - 2 per cent per week. In the case of seeds stored under 75 per cent RH, the quantum increase in seed moisture content over a period of five weeks was only 7.7 per cent enhancing the seed moisture level from 8.0 to 15.7 per cent. The initial rate of absorbtion by the seeds was almost the same as that of 90 per cent RH ie. about 3.8 per cent during the first week of storage. However, it decreased drastically during the subsequent weeks pedalling at the rate of about 1.5 per cent except during the last week which was marked by rise of about 2.5 per cent.

In the case of 50 per cent RH storage, the quantum increased as well as the rate of absorbtion were at its lowest ebb. The seeds attained only 4.6 per cent increase in seed moisture content over a period of five weeks. In this case also, the initial increase was rather fast (2.0 per cent) followed by a very slow absorbtion rate of 0.2 per cent during the subsequent two weeks and about 1 per cent during the fourth and fifth weeks of storage. Thus the seeds attained distinct moisture level under specified RH conditions at each period of storage.

Germination (Table 18)

The percentaged germination of bellary onion seeds stored under different RH levels showed significant differences. Loss in germination was rather very steep in the seeds stored under 100 per cent RH level. It declined from 86 to 15 per cent within one week of storage accounting for a loss of 71 per cent. Besides, the seeds were completely smothered by fungi and hence further testing could not be carried out with these seeds.

Table 18. Effect of different RH levels on the germination(%) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	86.0 (68.03)	86.0 (68.03)	86.0 (68.03)	86.0 (68.03)	86.0 (68.03)
W_1	15.0 (22.78)*	86.7 (68.62)	82.7 (65.40)	86.0 (68.04)	67.6 (56.21)
W_2	-	43.0 (40.98)	43.7 (41.36)	84.3 (66.70)	42.8 (37.26)
W_3	-	40.0 (39.23)	41.7 (40.20)	81.0 (64.16)	40.7 (35.90)
W_4	-	36.0 (36.87)	40.0 (39.23)	76.7 (61.13)	38.2 (34.31)
W_5	-	25.0 (30.00)	28.7 (32.37)	73.7 (59.13)	31.8 (30.37)
Mean	16.8 (15.14)	52.8 (47.29)	53.8 (47.77)	81.3 (64.53)	

* - The seeds were completely infected by saphrophytic fungi
Figures in parenthesis indicate arcsin values.

CD =(P = 0.05%)

Between W = 0.61
Between RH = 0.50
Between W x RH = 1.23

In the case of seeds stored under 90 per cent RH level, there was practically no loss in germination during the first week. From second week onwards it started declining significantly. The loss was about 50 per cent during the scond week and subsequently the rate decreased slowly in the range of 3%, 4% and 11 per cent during the third, fourth, and fifth weeks of storage, respectively. However, the difference in the reduction was significant at each period of storage.

As regards the seeds stored under 75 per cent RH, the quantum decrease in germination during the first week was about 3 per cent unlike that obtained with 90 per cent RH level for the same period of storage. During the second week of storage the decrease in germination was significantly more (39 per cent) and in the subsequent second third and fourth week, the reduction was rather very narrow (less than 2 per cent). After four weeks of storage, the germination percentage of seeds was significantly low (28.7 per cent at 4th week) striking a difference of 11 per cent from that of the previous week.

The seeds stored under 50 per cent RH level did not show any difference in germination during the first two weeks of storage. From third week onwards significant decrease was noticed. However, the rate of loss was low during subsequent weeks also which ranged between 2 and 5

Table 19. Effect of diffrent RH levels on the root length(cm) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	6.5	6.5	6.5	6.5	6.5
W_1	4.9*	6.4	6.5	6.3	6.0
W_2	-	6.5	5.7	6.3	4.6
W_3	-	6.1	5.3	6.5	4.5
W_4	-	5.0	4.4	6.3	3.9
W_5	-	3.7	4.0	6.2	3.5
Mean	1.9	5.7	5.4	6.4	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.07
Between RH = 0.06
Between W x RH = 0.15

per cent only. The total loss in germination of seeds over five weks of storage was only 12 per cent.

Root length (Table. 19)

The results of growth measurements (root length) of 12 day old seedlings showed significant differences due to relative humidity levels and period of storage as well as their intractions.

The results in respect to seeds stored under 100 per cent RH were significant with a decrease in root length of about 25 per cent (from 6.5 to 4.9 cm) within one week of storage the rate of decrease was very steep when compared to other treatments. Since the seeds were discarded after a week of storage due to fungal infection further testing could not be made on these seeds.

In respect to seeds stored under 90 per cent RH, the root length differences noticed upto two weeks were very small (about 2 per cent) and were on par to each other. Subsequent to that, drastic reduction in the root length was observed at the rate of 6, 15 and 20 per cent during the third, fourth and fith week of storage, respectively . The total reduction in root length was 2.8 cm (43 per cent) on account of five weeks storage at 90 per cent RH atmosphere.

In case of seeds stored under 75 per cent RH , the root length of seedlings remained unchanged during the first week (6.5 cm). Subsequently it decreased significantly during the second, third, fourth and fifth week of storage. The total reduction in root length was 2.5 cm over five weeks period accounting for 38.5 per cent. However, no consistency in the rate of reduction was noticed between the individual period of storage. For example, it was 12 per cent reduction in the second week, 6 per cent at the third and 14 per cent at fourth week.

The seeds stored in an environment of 50 per cent RH didnot reveal significant differences in root length during the storage period and undergone only a minimum reduction of 0.3 cm which was only 4.6 per cent of the initial value. A over view of results showed a reduction in root length of 4.6 to 23.0 per cent in different RH regimes.

Shoot length (Table. 20)

The shoot length measurements revealed significant differences as in the case of root length. The seeds stored at 100 per cent RH showed rapid and great reduction within one week to an extent of 29 per cent bringing down the actual length from 11.3 to 8.0 cm. Under 90 per cent RH atmosphere the seeds took almost five weeks to reach that level of reduction in shoot length (8.1 cm). During

Table 20. Effect of different RH levels on the shoot length(cm) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	11.3	11.3	11.3	11.3	11.3
W_1	8.0*	9.7	10.7	12.2	10.2
W_2	-	9.4	10.1	11.1	7.6
W_3	-	9.0	9.7	10.3	7.3
W_4	-	8.6	9.4	9.6	6.9
W_5	-	8.1	9.2	9.4	6.7
Mean	3.2	9.3	10.1	10.7	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.10
Between RH = 0.08
Between W x RH = 0.20

the first week, the reduction in shoot length was rather steep to an extent of about 14 per cent and subsequently it showed down to 3.0, 4.2, 4.4 and 5.8 per cent respectively at the second, third, fourht and fifth week. Over five weeks of storage the mean decrease was 28 per cent with an actual reduction of 3.2 cm.

In the case of seeds stored under 75 per cent RH environment, the reduction in shoot length after five weeks was from 11.3 to 9.2 cm which accounted for 19 per cent when compared to the initial values. The rate of decrease however, showed a different trend where, upto two weeks, it was in the order of 5.3 per cent the next two subsequent weeks at 3.5 per cent and during the fifth week it got reduced at 2 per cent level.

In respect to seeds stored under 50 per cent RH the total biological loss in shoot length was comparatively low (16.8 per cent) when compared to other humidity levels. The rate of reduction was also very slow during the first three weeks and their differences were also on par to one another. During the fourth and fifth week of storage it gained momentum and decreased at the rate of about 15 per cent.

Table 21. Effect of different RH levels on the drymatter production(mg) 10^{-1} seedlings of bellary onion seeds under room temperature

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	15.0	15.0	15.0	15.0	15.0
W_1	8.7*	12.7	12.0	13.7	11.8
W_2	-	9.5	10.6	12.0	8.0
W_3	-	9.3	9.7	10.0	7.2
W_4	-	8.6	8.7	9.6	6.7
W_5	-	7.5	8.3	9.3	6.3
Mean	4.0	10.4	10.7	11.6	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.30
Between RH = 0.25
Between W x RH = 0.60

Dry matter production (Table. 21)

The dry matter production of seedlings showed significant differences between RH levels and period of storage.

Under 100 per cent RH, the DMP of seedlings suffereed rapid and steep fall to an extent of 42 per cent within a week of storage. In respect to seeds stored under 90 per cent and 75 per cent RH levels it took almost four weeks to reach that level. At each RH level, the quantum decrease as well as the rate varied. The total biological loss was 50, 45 and 38 per cent, respectively at 90, 75 and 50 per cent RH levels. Although the rate of deterioration, agreed a general trend marked by a rapid decrease during the first week which was narrowed/slowed down during the subsequent weeks. As the level of RH decreased the slope of the curve also decreased which explained differences for the quantum change. Although the trend remained the same conserning the RH levels, consistent difference in the percentage reduction between any two periods could not be observed under each RH levels.

Vigour index (Table 22 and 23)

The results of the vigour indices computed by two methods, keeping the germination percentage of seeds as the common parameter, and the other being, DMP (method I) and total seedling length (method II) revealed parallel

Table 22. Effect of different RH levels on the vigour index I (G% x DMP) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	1290	1290	1290	1290	1290
W_1	131*	1098	992	1242	866
W_2	-	413	465	1012	472
W_3	-	371	404	810	396
W_4	-	308	349	736	348
W_5	-	187	237	683	277
Mean	237	611	623	962	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 25.23
Between RH = 20.60
Between W x RH = 50.46

Table 23. Effect of different RH levels on the vigour index II(G% x TSL) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	1531	1531	1531	1531	1531
W_1	194.0*	1396	1419	1594	1151
W_2	-	682	696	1465	711
W_3	-	603	626	1361	648
W_4	-	491	552	1222	566
W_5	-	295	377	1152	456
Mean	288.0	833	866	1387	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 14.65
Between RH = 11.96
Between W x RH = 29.30

results. With the reduction in RH level of the storage environment the process of seed deterioration, as revealed by VI values increased concomittently. In contrast as the period of storage (weeks) increased, the vigour index values decreased significantly in both the cases, establishing a negative association.

Although the trend of results remained the same, the percentage values showed differences for example; it was 89 per cent decrease under 100 per cent RH with method I and 87 per cent with method II within one week of storage. Under 90 per cent RH, the values registered were 86 per cent and 81 per cent respectively for the former and latter situations. In the case of 75 per cent and 50 per cent RH storage conditions, the value obtained were 82 and 47, 75 and 25 per cent respectively over a period of five weeks, exhibiting differences in the methods adopted for computation of VI for different treatment effects. But the percentage decrease values did not strike near values although the general trend was almost the same under 90 and 75 per cent RH levels beyond second week of storage and significantly different at 50 per cent RH. In both the approaches, consistent results could not be acheived (Particularly the percentage decrease) between weekly intervals of storage.

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anges in moisture content, germination, vigour index, EC in Bellary onion seeds stored in different RH levels.

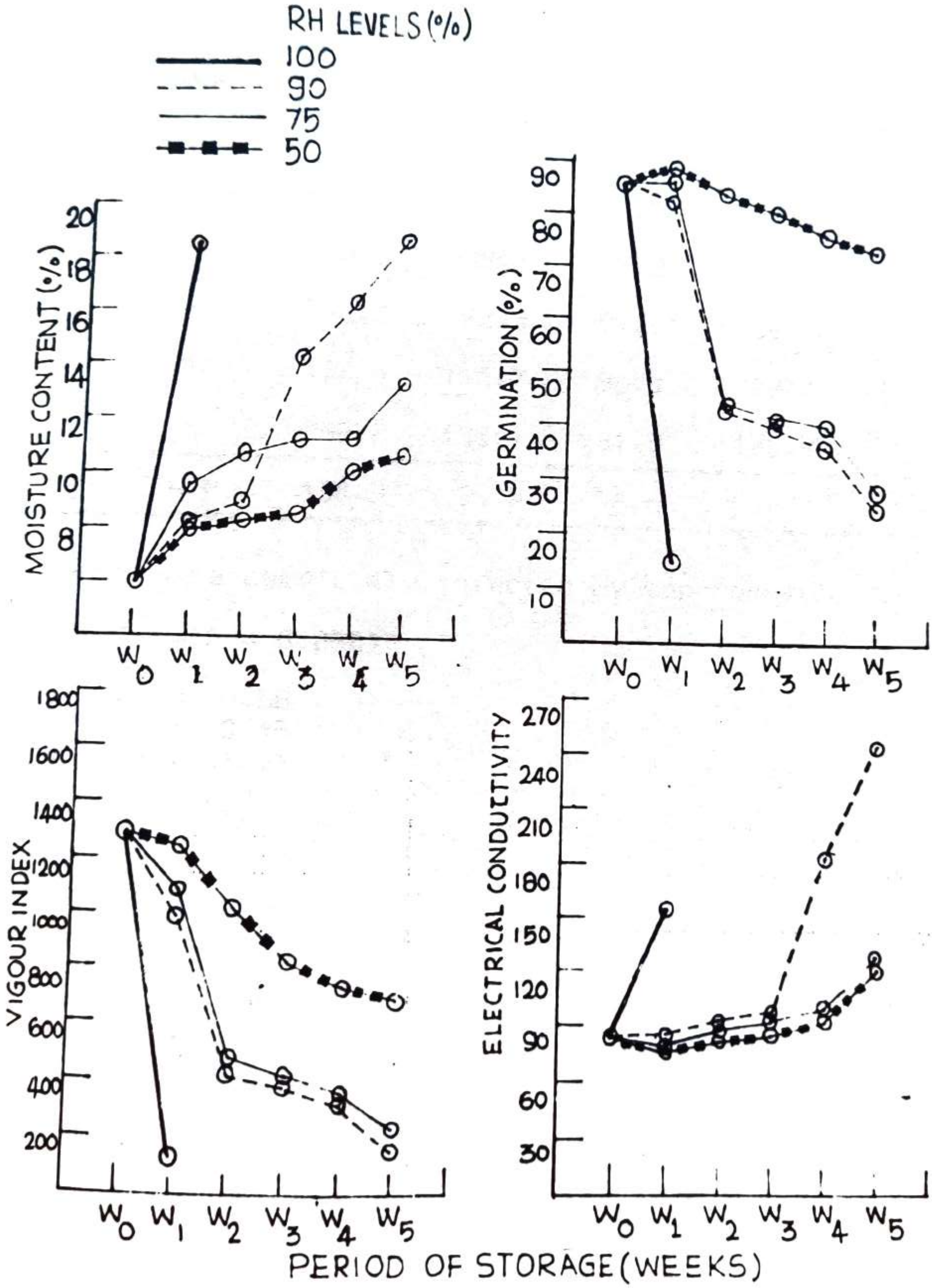

Table 24. Effect of different RH levels on the electrical conductivity (μ-mhos cm^{-1}) of bellary onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	85.2	85.2	85.2	85.2	85.2
W_1	151.3*	87.0	85.7	87.0	102.8
W_2	-	90.3	88.7	88.3	66.8
W_3	-	92.3	92.3	91.0	68.9
W_4	-	186.0	112.7	96.0	98.7
W_5	-	240.8	135.1	131.9	126.9
Mean	39.4	130.3	99.9	96.6	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.55
Between RH = 0.45
Between W x RH = 1.11

The actual reduction in VI values was 1159 (within a week), 1103, 1053, 607 (over five weeks of storage) under 100, 90, 75 and 50 per cent RH levels as assessed by method I and 1397, (within a week) 1236, 1154, 379 (over five weeks) respectively under 100, 90, 75 and 50 per cent RH levels in respect to method II.

Electrical conductivity (Table. 24)

EC values, showed significant differences between RH levels and period of storages. In both the cases, the association was positive decrease in RH levels decreased the mean EC values and vice-versa with period of storage. In all the cases, the differences were distinct and significant.

Under 100 per cent RH level, the quantum increase as well as the rate was steep, 44 per cent increase within one week of storage enhancing the EC values from 85 to 151 μ.mhos cm^{-1}. Under 90 per cent RH, the seeds took almost four weeks to attain about the near value of 186 μ.mhos cm^{-1} EC values steadily increased with increase in storage period (weeks). At the fourth and fifth week there was drastic increase to an extent of 50 and 55 per cent respectively. At 75 per cent RH the difference was meagre for the first two weeks and there after, it increased steadily with passage of time, the rate of increase in EC

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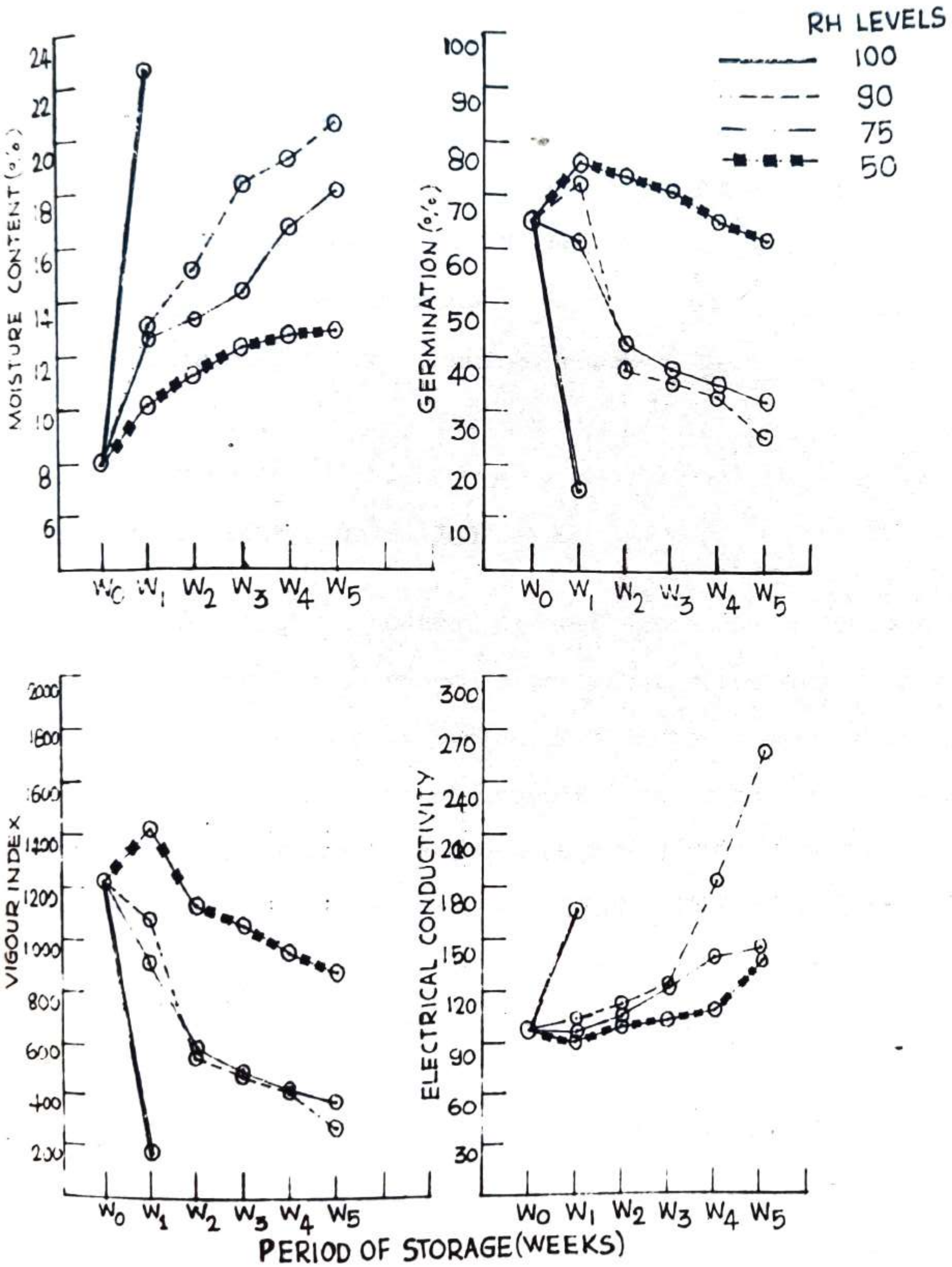
nges in moisture content, germination, vigour index & d electrical conductivity in aggregatum onion seeds stored in different RH levels



values was not as steep as in 90 per cent RH. The total increase at the end of fifth week was 40 per cent higher than initial value and the mean EC values ranged from 85.2 to 135 µ.mhos cm^{-1}. In 50 per cent RH storage the mean EC vlues inceased from 85.2 to 131.9 µ.mhos cm^{-1} over a period of five weeks which accounted for 55 per cent increase over the initial value. Compared to the other RH levels, the quantum as well as the rate of increase were comparatively low although the values significantly differed between storage periods (weeks).

Aggregatum onion

Moisture content (Table. 25)

The moisture content of seed stored under RH levels at ambient condition showed significant differences due to relative humidity levels, period of storage as well as their intractions. The overal results revealed that, with increase in RH level, the seeds absorbed more moisture and thereby, the seed moisture content increased significantly.

At each RH level, the quantum increase as well as the rate and speed of moisture absorbtion exhibited large variations. For example under 100 per cent RH level, the quantum jump in moisture content was 14.1 per cent over a period of one week to raise the moisture level from 8.1 to 22.2 per cent. On the other hand, under 90 per cent RH

Table 25. Effect of different RH levels on the moisture content(%) of Aggregattum onion seeds under room temperature storage

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	8.1	8.1	8.1	8.1	8.1
W_1	22.2*	13.0	12.8	10.0	14.5
W_2	-	15.0	13.1	11.2	9.8
W_3	-	18.1	14.1	12.3	11.1
W_4	-	19.3	16.6	12.6	11.1
W_5	-	22.3	18.0	12.8	13.3
Mean	5.0	16.0	13.8	11.2	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.20
Between RH = 0.18
Between W x RH = 0.45

level seeds took almost five weeks to reach that moisture level of about 22.3 per cent. Since the seeds were completly infected by fungi at 100 per cent RH, further observations could no be recorded and hence the seeds were discarded. Under 90 per cent RH, level the seeds took almost five weeks to reach that moisture level of 22.3 per cent. The rate of imbibition was about 4.9 per cent over a period of one week. Subsequently the rate of absorbtion fluctuated within the range of 2 to 3.1 per cent per week during the remaining period.

In the case of seeds stored under 75 per cent RH, the quantum increase in moisture content over a period of five weeks was only 9.9 per cent, enhancing the seed moisture level from 8.1 to 18 per cent. Initial rate of absorbtion was almost the same as in 90 per cent RH ie. 4.7 per cent during the first week of storage. However, it decreased drastically during the subsequent weeks except during the fourth weeks of storage which marked 2.5 per cent rise in moisture content.

In the case of 50 per cent RH storage, the quantum increase as well as the rate of absorbtion was at its lowest ebb. The seeds attained only 4.6 per cent moisture content over a period of five weeks. In this case also, the initial increase was rather steep (2.0 per cent) followed by a very slow absorbtion rate of 0.3 and 0.2 per

Table 26. Effect of different RH levels on the germination(%) of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	65.0 (53.73)	65.0 (53.73)	65.0 (53.73)	65.0 (53.73)	65.0 (53.73)
W_1	15.0 (22.78)*	72.3 (58.69)	61.7 (51.75)	76.7 (61.12)	56.4 (48.59)
W_2	-	38.7 (38.45)	43.7 (41.36)	74.3 (59.56)	39.2 (34.84)
W_3	-	36.0 (36.87)	38.3 (38.25)	71.3 (57.63)	36.4 (33.19)
W_4	-	33.0 (35.06)	35.0 (36.27)	65.7 (54.14)	33.4 (31.37)
W_5	-	25.3 (30.22)	32.7 (35.26)	63.3 (52.73)	30.3 (29.55)
Mean	13.3 (12.75)	45.1 (42.17)	46.1 (42.76)	69.4 (56.49)	

* - The seeds were completely infected by saphrophytic fungi
Figures in parenthesis indicate arcsin values.

CD =(P = 0.05%)

Between W = 0.46
Between RH = 0.38
Between W x RH = 0.92

cent during the fourth and fifth week of storage, respectively.

Germination (Table. 26)

The percentaged germination of aggregatum seeds stored under different RH levels showed significant differences. Loss in germination was rather very steep in the seeds stored under 100 per cent RH. It declined from 65 to 15 per cent within one week of storage. Moreover the seeds were proned to attack by saphrophytic fungi.

Under 90 per cent RH there was no decline in germination during the first week but from the second week onwards, it started declining significantly. The loss was from 72.3 to 38.7 per cent after second week of storage. Subsequently the rate of decrease was rather slow within the range of 2.7 to 7.7 per cent. However, the difference in the rate of decrease was significant at each period of storage.

Regarding the seeds stored under 75 per cent RH, the quantum decrease in germination during the first week was only about 3.3 per cent. The decrease in germination during the second week of storage was significantly more (18 per cent). During the subsequent weeks ie., the third, fourth and fifth, the decrease in germination was rather

Table 27. Effect of different RH levels on the root length(cm) of Aggregatum onion seeds under room temperature

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	5.1	5.1	5.1	5.1	5.1
W_1	3.6*	5.3	5.1	6.9	5.2
W_2	-	5.1	4.4	5.6	3.8
W_3	-	4.6	4.0	5.4	3.5
W_4	-	4.1	4.0	5.1	3.3
W_5	-	3.3	3.6	4.7	2.9
Mean	1.5	4.6	4.4	5.5	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.07
Between RH = 0.06
Between W x RH = 0.14

slow and differences were very narrow (less than 5.4 per cent). In five weeks of storage, the germination loss was significantly low (32.7 per cent).

The seeds stored under 50 per cent RH showed an increased in trend in germination upto four weeks of storage (from 65 to 76.7 per cent). The decrease noticed after five weeks of storage was only 2.4 per cent from the initial value.

Root length (Table. 27)

The results of root growth measurements made on 12 day-old seedlings from seeds stored under different RH levels showed significant differences due to RH levels and period of storage as well as their intractions.

The results pertaining to the seeds stored under 100 per cent RH showed significant reduction in root length from 5.1 to 3.6 cm (41.1 per cen) within one week of storage. The rate of decrease was very steep when compared to other treatments. Since the seeds were discarded after a week of storage, further testing could not be made on these seeds.

In respect to seeds stored under 90 per cent RH, the root length decreased to 3.3 cm almost five weeks after storage. After the first and second weeks of storage, the

Table 28. Effect of different RH levels on the shoot length(cm) of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	10.6	10.6	10.6	10.6	10.6
W_1	7.5*	9.4	9.6	11.5	9.5
W_2	-	9.3	9.5	9.7	6.9
W_3	-	8.7	8.5	9.4	6.7
W_4	-	8.4	8.3	9.3	6.5
W_5	-	7.5	8.0	9.1	6.2
Mean	3.0	9.0	9.0	9.9	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.06
Between RH = 0.05
Between W x RH = 0.13

root length was almost maintained 5.3 and 5.1 cm, respectively. Subsequently there was drastic reduction in root length to 4.1 cm in fourth week.

In the case of seeds stored under 75 per cent RH atmosphere, the root length of seedlings remained unchanged during the first one week from that of the initial value of 5.1 cm. Subsequently, it decreased significantly during second, third, fourth and fifth week of storage. The total reduction in root length was 1.5 cm over the entire period of five weeks accounting for 29.1 per cent reduction ie., from 5.1 to 3.6 cm.

Under 50 per cent RH level there was an increasing trend even after four week of storage only after the fifth week of storage, a significant reduction was observed ie. from 5.1 to 4.7 cm.

Shoot length (Table 28)

The shoot length of seedlings showed significant differences due to relative humidity and period of storage as well as their interactions. Under 100 per cent RH levels reduction was 29 per cent over a period of one week by reducing their mean values from 10.6 to 7.5 cm.

Under 90 per cent RH level over a peiod of five weeks, the reduction in shoot length was from 10.6 to 7.5 cm only. The rate of reduction however, was 11.3 per cent during the first week and subseqeuntly 1.0, 6.4, 3.4 and 10.7 per cent at the second, third, fourth and fifth weeks, respectively.

Under 75 per cent RH level reduction in shoot length after five weeks was from10.6 to 8.0 cm which accounted for 24 per cent. The rate of decrease was almost parallel to that of 90 per cent RH level. When compared to the initial values, the rate of decrease however, showed decreasing trend. After two weeks of storage it was with order of 1 per cent and in the subsequently week it was markedly higher 10.5 per cent which again reduced to the level of 2.3 and 3.6 per cent on the fourth and fifth week, respectively.

In respect to the seeds stored under 50 per cent RH, the total biological loss in shoot length was comparatively low (14 per cent) as against the other humidity levels. Under 50 per cent RH level, an increase in shoot length was noticed one week after storage 7.8 per cent. Subsequently, the reduction was very slow even after five weeks of storage. shoot length got reduced from 10.6 to 9.1 cm which accounted for about 14 per cent.

Drymatter production (Table. 29)

Drymatter porduction of seedlings showed significant differences due to RH and period of storage.

Table 29. Effect of different RH levels on the drymatter production(mg)/10 seedlings of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%)				Mean
	100	90	75	50	
W_0	12.0	12.0	12.0	12.0	12.0
W_1	6.6*	9.2	9.6	13.7	9.8
W_2	-	8.8	9.3	11.7	7.4
W_3	-	8.5	9.3	9.7	6.8
W_4	-	7.8	8.5	9.5	6.4
W_5	-	6.8	7.9	9.3	6.0
Mean	3.1	8.8	9.4	10.9	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.15
Between RH = 0.12
Between W x RH = 0.29

Table 30. Effect of different RH levels on vigour index I(G% x DMP) of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	780	780	780	780	780
W_1	99*	674	592	1015	595
W_2	-	339	405	865	403
W_3	-	304	344	692	334
W_4	-	256	299	622	294
W_5	-	172	259	581	253
Mean	146	421	446	759	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 9.12
Between RH = 7.45
Between W x RH = 18.24

Table 31. Effect of different RH levels on the vigour index II(G% x TSL) of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	1021	1021	1021	1021	1021
W_1	168*	1075	906	1408	889
W_2	-	554	575	1135	566
W_3	-	480	482	1056	504
W_4	-	414	427	943	446
W_5	-	273	380	874	382
Mean	198	636	632	1073	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 10.97
Between RH = 8.95
Between W x RH = 21.93

under 100 per cent RH, the seedlings showed very rapid and steep fall in DMP potential to an extent of 45 per cent within a week of storage, from 12 to 6.6 mg. At each RH level the quantum decrease as well as the rate of decrease varied significantly. The total biological loss was 43, 34 and 23 per cent, respectively at 90, 75 and 50 per cent RH levels. However, in respect to rate of deterioration a general trend was observed where it was rapid during first week at all RH levels and almost flattened at subsequent storage periods. As the RH decreased the slope of curve decreased which accounted for the quantum difference. The trend of results although remained th same, depending the RH levels, consistant difference in the percentage values was not observed between periods.

Vigour index (Table 30 and 31)

With reduction in RH level of the storage environment, the process of seed deterioration decreased as revealed by the VI values. In contrast, as the period of storage (weeks) increased, the vigour index values decreased significantly (in both the cases) establishing a negative association.

Although the trend of results remained the same at all RH levels, the percentage values showed differences. For example, it was 87 per cent decrease under 100 per cent RH when DMP was considered for computation as against 83

Table 32. Effect of different RH levels on the electrical conductivity μ mhos cm^{-1} of Aggregatum onion seeds under room temperature storage

Duration (weeks)	RH levels (%) 100	90	75	50	Mean
W_0	70.2	70.2	70.2	70.2	70.2
W_1	143.3*	77.0	74.0	71.1	91.4
W_2	-	85.7	81.7	74.3	60.4
W_3	-	95.0	91.3	77.7	66.0
W_4	-	165.7	109.0	83.0	89.4
W_5	-	231.7	116.0	109.0	114.2
Mean	35.6	120.9	19.4	18.9	

* - The seeds were completely infected by saphrophytic fungi

CD =(P = 0.05%)

Between W = 0.70
Between RH = 0.58
Between W x RH = 1.41

per cent with Total seedling length, within one week of storage. Under 90 per cent RH, the values registered were 77 and 73 per cent respectively for the former and latter situations. In the case of 75 per cent and 50 per cent RH storage conditions, the values obtained were 67 per cent and 63 per cent respectively over a period of five weeks, exhibiting differences in the methods adotped for the computation of VI for the assessment of treatment effects. In both the cases consistent results could not be achieved particularly when expressed in terms of percentage decrease.

In the case of 50 per cent RH level the values obtained were 25.5 and 14.3 per cent respectively. The acutal reduction in VI values was 681 (within a week) 608, 521, 199 (over five weeks of storage) under 100, 90, 75 and 50 per cent RH levels as assessed by method I and 853 (within one week) 748, 641, 147 (over five weeks respectively under 100, 90, 75 and 50 per cent RH levels in respect to method II.

Electrical conductivity (Table. 32)

The EC values, showed significant differences between RH values and period of storage. In both the cases, the association was positive - decrease in RH levels decreased the mean EC values and vice-versa with period of storage. In all the cases the differences were distinct and significant.

Table 33. Seed Quality of bellary onion following accelerated ageing (100% RH$ and 40 C) for different duration in days

Duration (days)	Germination (%)	Root length (cm)	Shoot length (cm)	Drymatter production mg/10 seedlings	Vigour index (G% x TSL)
0	91 (72.6)	6.5	12.8	18	1603
1	87 (68.9)	5.7	12.2	19	1559
2	84 (66.8)	4.5	10.7	17	1280
3	79 (62.7)	4.8	9.7	14	1151
4	76 (60.3)	4.1	8.0	12	917
5	60 (50.9)	3.8	9.4	11	798
6	53 (46.7)	3.5	9.2	12	633
7	41 (39.6)	4.1	8.6	9.9	520
8	13 (21.0)	3.5	7.8	9.6	148
9	19 (26.7)	3.4	7.6	9.0	224
10	1 (05.0)	2.8	6.1	8.7	44
CD=(P=0.05%)	3.0	0.18	0.21	0.35	140

Under 100 per cent RH level the rate of increase in electrical conductivity was 51 per cent over a period of one week enhancing EC values from 70.2 to 143.3 μ.mhos cm^{-1}. Under 90 per cent RH the seeds took almost four weeks to record almost the value of 231.7 μ.mhos cm^{-1}.

The EC values steadly increased with increase in storage period (weeks). At fifth week, there was drastic increase in electrical conductivity to the level of 69 per cent from the initial value. At 75 per cent RH the difference was not as steep as in 90 per cent RH. The total increase at the end of fifth week was 30 per cent hiher than the intial value. The mean values ranged from 70.2 to 109 μ.mhos cm^{-1} over a period of five weeks which accounted for 35 per cent over the initial value. When compared to other RH levels, the quantum as well as the rate of increase were comparatively low although the values differed significantly between storage periods (weeks).

Accelerated ageing (Table. 33)

The percentaged germination differed significantly between the ageing periods. The rate of germination was acclerated and declined rapidly from D_1 to D_{10} the lowest germination rate of one was observed at 10 th day.

The root length of seedlings from seeds following accelerated ageing revealed consistent results. As the days of ageing advanced, the reduction in root length was cumulative. The percentage decrease noticed was in the order of 12.3, 30.8, 36.9, 41.5, 46.2, 47.7 and 56.9, for the first through tength day of accelerated ageing.

Similar results have been obtained in respect to shoot length, where the reduction noticed was from 4.7 to 52.3 per cent from first to tenth day of ageing. When compared to root length reduction the reduction in shoot length noticed was less.

In respect to DMP, cumulative effect of ageing was clearly brought out with parallel results. The drymatter loss was from 19 mg to 8.7 mg in 10 days of accelerated ageing which accounted for 51.6 per cent of the initial value.

Senescence pattern under accelerated ageing condition

The topographical tetrazolium test has been used to trace seed senescence pattern under accelatated ageing condition (40° C and 100 per cent RH). The study was carried out with processed seeds of bellary onion cv. Nasik red. The staining pattern of the embryo was studied at one day interval of ageing to locate the area/specific part of the embryo which senescence first as revealed by the unstained tissues of embryo. Observation made under microscope indicated that the deterioration started from the root apex and progressed upward to the adjoining mesocotyl region almost simultaneously. It progressed further to the region of cotyledens and finally to the embryonic axis. The overall results indicated that as the ageing process advanced the number of unstained seeds or seeds with indefinite staining pattern became more. The staining pattern however, was alike in the early period of ageing. Almost all the seeds were dead (88 per cent) within nine days (22 seeds out of 25) of ageing.

Hydration and dehydration treatment

Bellary onion

Germination (Table. 34)

The results revealed significant difference in the percentaged germination between the control and hydrated dehydrated seeds. Even immediately after treatment an increase in germination over control ie. from 87.5 to 90 per cent was seen. Five months after storage the germination decreased from 87.5 to 64.5 per cent in the control (untreated seeds) and from 90.0 to 68.5 per cent in treated seeds, respectively. The biological loss upon storage also revealed the superiority of hydrated - dehydrated seeds over the control by registering 26.3 and 23.9 per cent, respectively. The interaction however, was not significant.

Fig 5 .Effect of H - DH treatment on the germination and vigour of stored Bellary Onion seeds

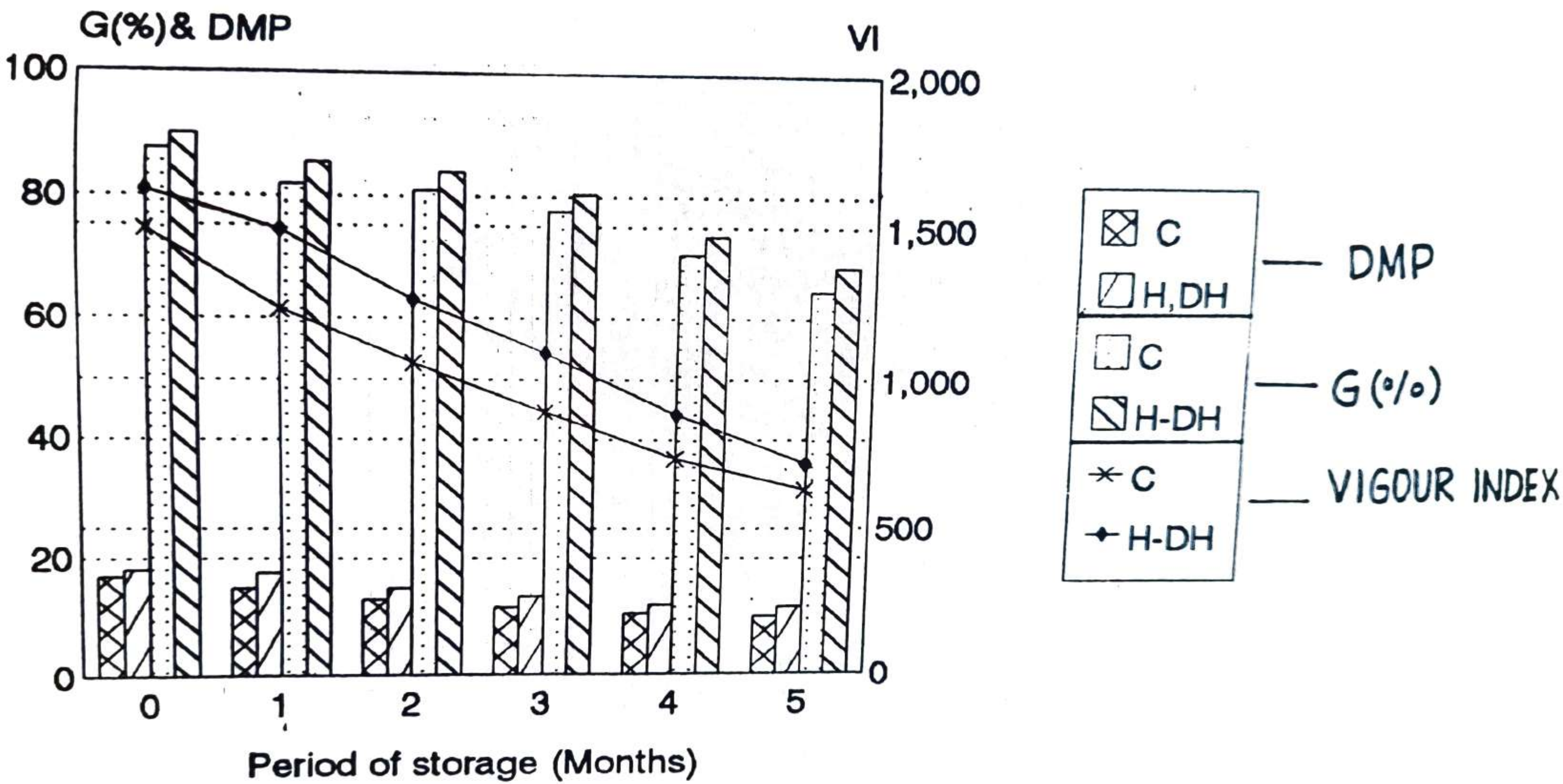


Table 34. Effect of hydration - dehydration treatment on the germination (%) and root length (cm) of bellary onion seeds stored under ambient condition

Period of storage (months)	Germination(%)		Root length(cm)	
	Control	H - DH	Control	H - DH
0	87.5 (69.3)	90.0 (71.6)	7.7	8.1
1	82.0 (64.9)	85.5 (67.2)	7.4	7.8
2	81.0 (64.2)	84.0 (66.4)	7.2	7.6
3	77.5 (61.8)	80.5 (63.8)	6.2	6.6
4	70.5 (57.1)	73.5 (59.0)	6.1	6.3
5	64.5 (53.4)	68.5 (55.9)	5.7	6.1
Treatment mean	77.2 (61.8)	80.3 (64.0)	6.7	7.08
BLS(%)	26.3	23.9	26.0	24.7

	Germination	Root length
CD = (0.05%)		
T	0.64	0.09
P	1.11	0.16

Table 35. Effect of hydration - dehydration treatment on shoot length(cm) and drymatter production(mg) of bellary onion seeds stored under ambient conditions

Period of storage (months)	Shoot length(cm)		Dry matter Production	
	Control	H - DH	Control	H - DH
0	9.3	9.5	17.0	18.0
1	9.3	9.6	15.0	17.5
2	9.1	9.5	13.0	15.0
3	8.7	8.9	11.5	13.5
4	8.2	8.5	10.5	12.0
5	7.5	7.9	9.8	11.5
Treatment mean	8.7	9.0	12.8	14.6
BLS(%)	19.4	16.8	42.4	36.1

CD = (0.05%) — CD = (0.05%)

T = 0.14 — 0.42

P = 0.24 — 0.73

Table 36. Effect of hydration - dehydration treatment on the vigour index I (G% x DMP) and vigour index II (G% x TSL) of bellary onion seeds stored under ambient conditions

Period of storage (months)	Vigour index I		Vigour Index II	
	Control	H - DH	Control	H - DH
0	1488	1620	1483	1584
1	1230	1487	1370	1470
2	1053	1260	1313	1441
3	891	1087	1155	1232
4	737	882	1012	1088
5	632	719	852	942
Treatment mean	1005	1176	1197	1293
BLS(%)	57.5	55.6	42.6	40.5

	Vigour index I	Vigour Index II
CD = (0.05%)		
T	30.0	23.0
P	52.0	40.0

Root length (Table. 34)

The root length was significantly increased in treated seeds initially (5.2 per cent) as well as after five months of storage (7.0 per cent). The decrease in root length was from 7.7 to 5.7 cm in the control and 8.1 to 6.1 cm in treated seeds after five months of storage. The biological loss upon storage also revealed the difference in the rate of reduction in both the control and treated seeds. (26.0 and 24.7 per cent, respectively).

Shoot length (Table 35)

The difference in respect to shoot length was significant between the treated and control seeds. The increase was 0.2 cm initially and 0.4 cm after five months of storage. The reduction in shoot length observed in control was 19.3 per cent (from 9.3 to 7.5 cm) and 16.8 per cent in treated seeds after five months of storage. The Biological Loss in percentage revealed greater and lower reduction in the control and treated seeds by registering 19.4 and 16.8 per cent, respectively.

Drymatter production (Table. 35)

The treated seeds showed significant increase in dry matter production (DMP) over control soon after hydration - dehydration treatment. There was steady reduction upon storage in both the control and treated seeds five months after storage DMP reduced from 17 to 9.8 mg (42.4 per cent) in control seeds and 18 to 11.5 mg (36.1 per cent) in treated seeds.

Vigour index (Table. 36)

Significant differencs in VI values were observed for the treated and control seeds in both the method of computation ie. germination x DMP (method I) and germination x Total seedling length (method II). VI values reduced in accordance with storage period in both the treated and control seeds. The extent of loss was less in treated seeds and significantly more in control, for example 55.6 and 57.5 per cent vide method I and 40.5 and 41.6 per cent vide method II.

Aggregatum onion

Germination (Table. 37)

Hydration - dehydration treatment significantly enhanced the germination percentage of seeds both initially and after storage for five months. Significant reduction was noticed during storage, the extent was less in treated and more in control seeds. The corresponding values were 18.5 and 22.9 per cent, respectively. In other words the loss in germination was less in H - DH seeds.

Fig6. Effect of H - DH treatment on the germination and vigour of stored Aggregatum onion seeds

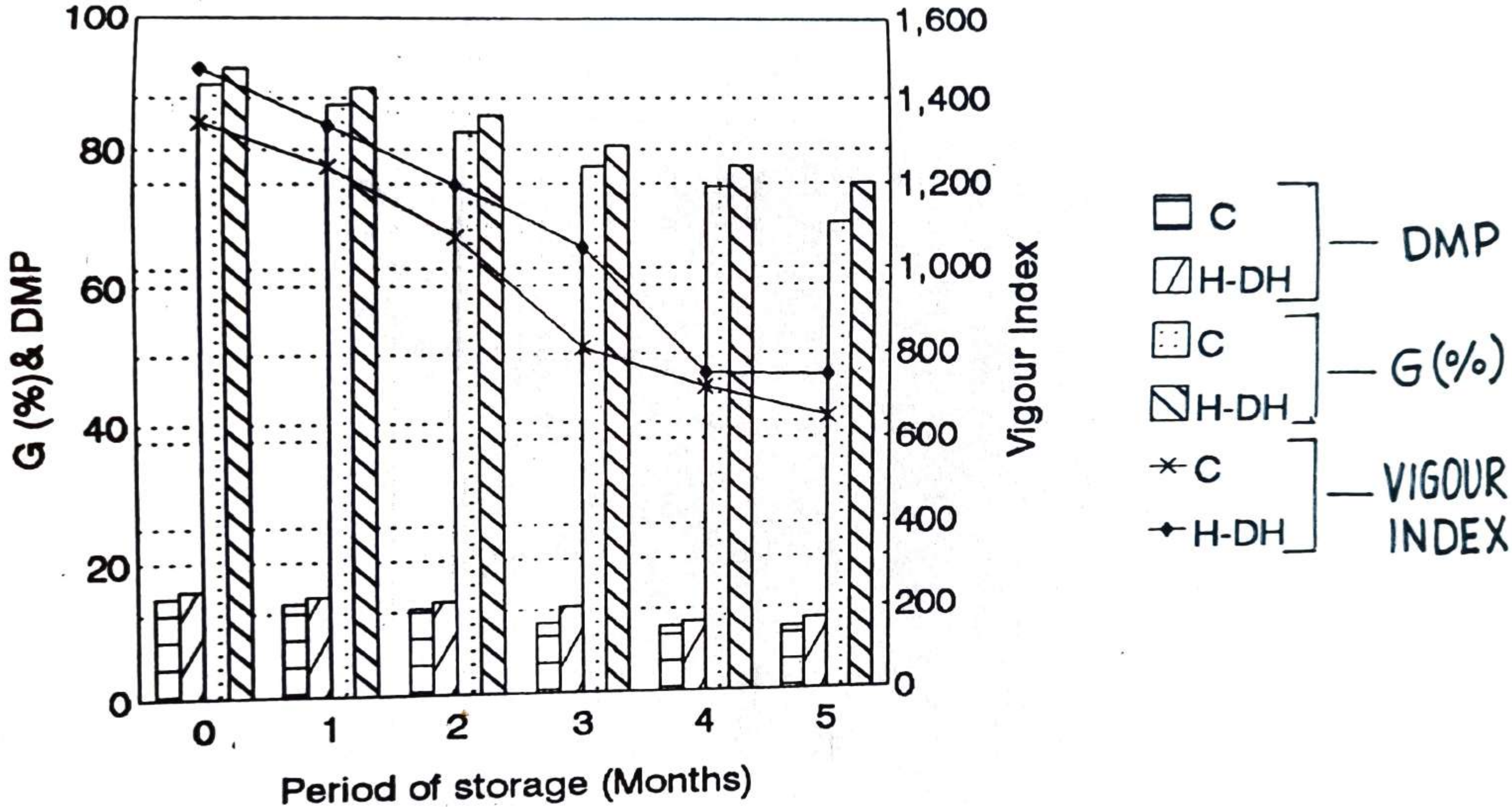


Table 37. Effect of hydration - dehydration treatment on the germination(%) and root length (cm) of Aggregatum onion seeds stored under ambient condition

Period of storage (months)	Germination(%)		Root length(cm)	
	Control	H - DH	Control	H - DH
0	89.5 (71.1)	92.0 (73.6)	6.4	6.6
1	86.5 (68.5)	89.0 (70.7)	6.3	6.3
2	82.5 (65.3)	85.0 (67.6)	5.8	6.1
3	77.5 (61.7)	80.5 (63.8)	5.1	5.3
4	74.5 (59.7)	77.5 (61.7)	5.0	5.4
5	69.0 (56.2)	75.0 (60.0)	4.5	5.1
Treatment mean	79.9 (63.7)	83.3 (66.22)	5.4	5.8
BLS(%)	22.9	18.5	-	-

CD = (0.05%)
T = 0.80
P = 1.38

CD = (0.05%)
0.12
0.20

Table 38. Effect of hydration - dehydration treatment on shoot length(cm) and drymatter production(mg) of Aggregatum onion seeds stored under ambient conditions

Period of storage (months)	Shoot length(cm)		DMP (mg)	
	Control	H - DH	Control	H - DH
0	7.8	8.0	15.0	16.0
1	7.6	7.8	14.0	15.0
2	7.2	7.5	13.0	14.0
3	7.1	7.2	10.5	13.0
4	6.4	6.9	9.7	10.5
5	6.3	6.7	9.5	10.7
Treatment mean	7.0	7.3	11.9	13.2
BLS(%)	19.2	16.2	36.7	33.1

	Shoot length	DMP
CD = (0.05%)		
T	0.23	0.32
P	0.40	0.55

Root length (Table. 37)

Significant increase in root length was observed in treated seeds with an increase from 6.4 to 6.6 cm initially and 4.5 to 5.1 cm after five months of storage. Upon storage the BLS was 22.7 and 39.6 per cent, respectively for the H - DH and control seeds.

Shoot length (Table. 38)

Results obtained were parallel to bellary onion seeds. Initially there was 2.6 per cent increase in shoot length in treated seeds over control and after five months the corresponding value was 6.3 per cent. The biological loss upon the storage was 16.2 and 19.2 per cent, respectively.

Drymatter production (Table. 38)

Significant difference was observed in respect to DMP of seedlings from treated and control seeds. The increase was one mg initially and 1.2 mg after five months of storage. The biological loss was 33 per cent and 36.7 per cent in treated and control seeds, respectively.

Vigour index (Table. 39)

Significant differences in VI values were observed for the H - DH and control seeds in both the methods of

Table 39. Effect of hydration - dehydration treatment on the vigour index I (G% x DMP) and vigour index II (G% x TSL) of Aggregatum onion seeds stored under ambient conditions

Period of storage (months)	Vigour Index I		Vigour Index II	
	Control	H - DH	Control	H - DH
0	1343	1472	1139	1269
1	1211	1335	1177	1251
2	1073	1197	1064	1159
3	815	1047	903	1002
4	723	756	842	950
5	652	750	739	879
Treatment mean	969	1093	998	1096
BLS(%)	51.5	49.0	35.1	30.8

CD = (0.05%)
T = 24.0
P = 42.0

CD = (0.05%)
14.0
24.0

computation ie., germination x DMP (method I) and germination x total seedling length (method II). VI values got reduced as the storage period advanced in both treated and control seeds. It was in order of 49.0 and 51.5 per cent as per method I and 30.8 and 35.1 per cent vide method II. The results indicated a slow decrease in H - DH seeds and vice-versa in control.

Effect of hydration - dehydration treatment on productivity

In order to ascertain the effect of hydration - dehydration treatment on the productivity of resulting crop, a field experiment was carried out using both the bellary and aggregatum onion seeds. The treatments were given at 5^{th}, 6^{th} and 7^{th} month after harvest of the mother seeds and subsequently stored for 3, 2 and one month, respectively before sowing in the nursery for field planting. The plot size adopted was (3.4 m^2) with 10 ridges for each treatment and replicated thrice. The morphometric trait such as plant height and yield data were recorded after the harvest of the crop.

Bellary onion (Table. 40)

The plant height data did not attain significant difference between treatments and the age of the seed. However, the plants from hydrated - dehydrated seeds largely showed a numerical increase except in T_2.

Table 40. Effect of hydration - dehydration treatment on the productivity - bulb yield (kg/3.4 m^2) and plant height (cm) in bellary onion cv. Nasik red

Treatment	Plant height (cm)			Bulb yield (kg)		
	Control	H-DH	%increase	Control	H-DH	%increase
T_1	60.8	62.5	+2.8	28.0	30.3	7.7
T_2	54.3	52.4	-3.5	25.7	27.7	7.3
T_3	47.5	48.9	+2.8	22.2	25.4	12.4
Mean	54.2	54.6	0.73	25.2	27.8	9.0

Plant height: CD = (P = 0.05%), C = NS, T = NS

Bulb yield: CD = (P = 0.05%), C = 1.2, T = 1.5

Fig8.Effect of H-DH treatment on productivity in Bellary onion

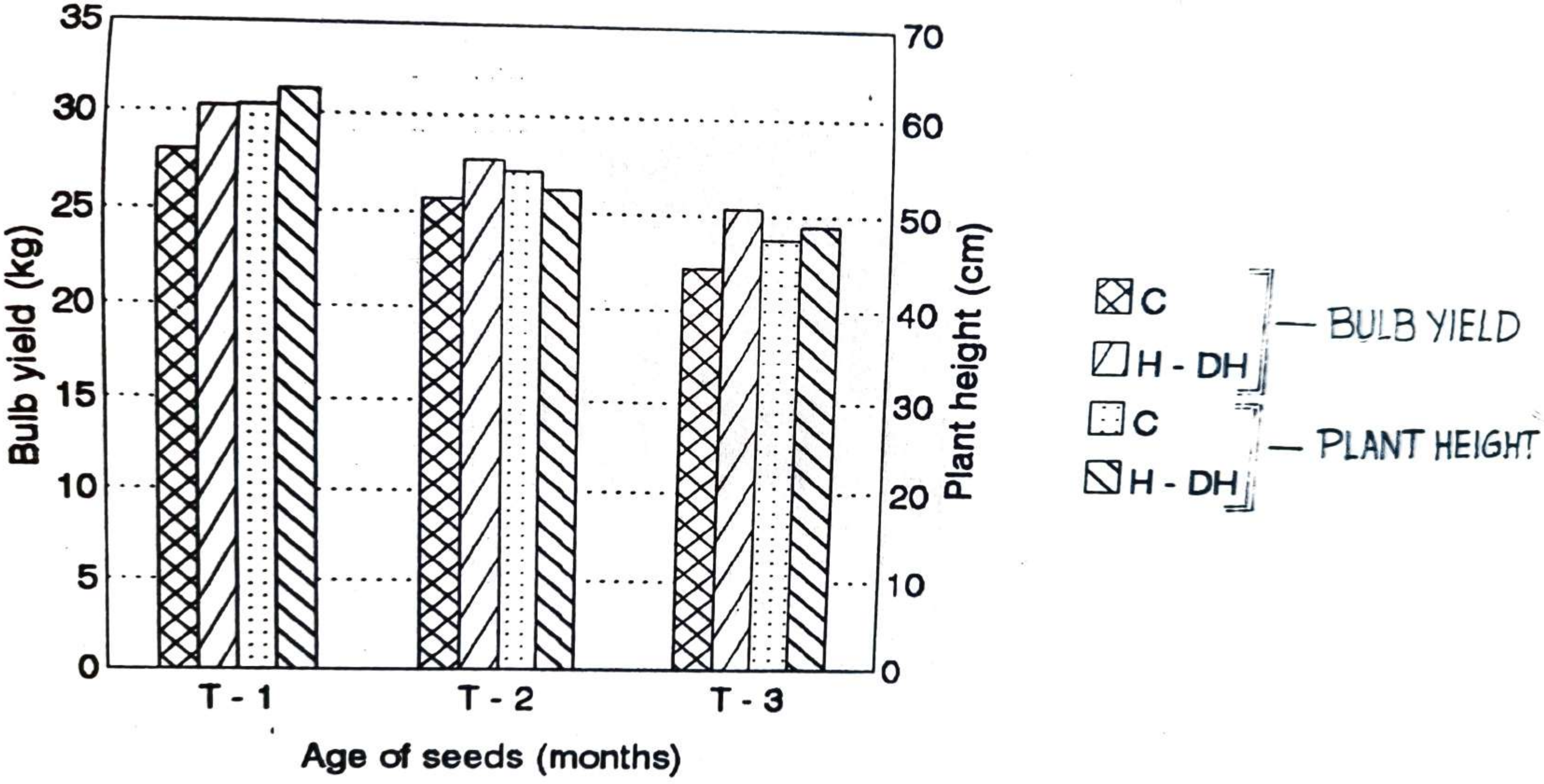


Table 41. Effect of hydration - dehydration treatment on the productivity - bulb yield (kg/3.4 m^2) and plant height (cm) in Aggregatum onion cv. Mutloor

Treatment	Plant height (cm)			Bulb yield (kg)		
	Control	H-DH	%increase	Control	H-DH	%increase
T_1	26.2	29.7	11.7	8.0	9.8	17.5
T_2	27.6	27.6	0.0	7.2	8.8	19.3
T_3	23.1	25.5	9.4	6.4	8.0	19.4
Mean	25.7	27.4	6.2	8.9	18.4	18.4

Plant height (cm)	Bulb yield (kg)
CD = (P = 0.05%)	CD = (P = 0.05%)
C = NS	C = 0.81
H-DH = NS	H-DH = 0.99
C x H-DH = NS	C x H-DH = 1.40

In respect to the bulb yield irrespective of the seed age the hydration - dehydration treatment resulted in a significant increase to an extent of 7.7 to 12.4 per cent. The seeds given hydration - dehydration treatment at 5th month gave the highest yield (30.3 kg 3.4/m^2) when compared to those given at 6th and 7th months of storage.

Aggregatum (Table. 41)

In the case of Aggregatum onion also the plant height was not altered by hydration - dehydration treatment or by the age of the seed. Although, a small numerical increase was observed in hydration - dehydration treatment.

In contrast, the bulb yield showed significant differences between the H - DH and control with all age groups. However, maximum yield of 9.8 Kg 3.4/m^2 was recorded in respect to the seeds given H - DH treatment at 5th month rather than given at 6th or 7th month. On percentage increase basis T_3 and T_2 showed higher values because of the significant reduction in the bulb yield obtained for the control seeds for T_2 and T_3 treatments.

The overall results concerning the bellary and aggregatum onion revealed that H - DH treatment besides, improving vigour and viability of seeds ultimately resulted in augmenting the productivity of the resultant crop. The results also categorically indicated that the optimum time for hydration - dehydration treatment will be 5 months after the harvest of the mother seeds for achieving the best beneficial effects.

Discussion

CHAPTER V

DISCUSSION

Seed size studies :

The harvested bulk seeds contain a wide range of seed sizes, but those may not have equal value for sowing. The method of grading and pocessing aims at removing presumably the non viable seeds and ensure that those finally used are uniform in size and shape (Dharmalingam, 1982).

Seeds of many agricultural and horticultural crops have been seperated based on size, weight, density and colour, which offer a means of improving seedling vigour and/or yield for many crops. In this context, the present investigation was instituted to standardise sieve size and evaluate quality of the different standard size grades of both bellary and aggregatum onion seeds.

The recovery percentage of large sized seeds of both bellary and aggregatum recorded 82 and 69 %, respectively, followed by medium and small seeds. Vijayakumar and Dharmalingam (1988) recorded higher recovery percentage for large sized seeds by size grading in cole crops such as cabbage, cauliflower, carrot and radish. Similar results were reported by Gamiely **et al.,** (1990) in onion and Kalavathi and Vanangamudi (1990) in cluster beans.

The 100 seed weight of the seed registered differences among the different size grades, in both type of onions. Borna and Haas (1969), Vijayakumar and Dharmalingam (1988) in onion and Ramasamy (1985) in Bhendi, and Balamurugan (1993) in sunflower, noted significant differences in 100 seed weight.

The germination percentage of large size seeds was the highest (91 %) for both classes of onion followed by those of the medium size seeds (83 %) in Bellary and 85 % in Aggragatum.

The relatively higher nutrient contents in larger seeds perhaps may be the reason for the high germination. The significant differences noted in vigour as measured by root and shoot length, dry matter production and vigour index of both the types of onion seed size classes. Similar results were reported by Sivasubramaniam and Ramakrishnan (1977), Senthilkumar Kalingarayar and Dharmalingam (1980), Dharmalingam and Ramakrishnan (1981) and Balamurugan (1993). In general large sized seeds had more dry matter production. It may be attributed to the effect of greater amount of food reserves in large sized seeds. This was in conformity with the results of Paul and Ramasamy (1979), Palanisamy and Ramasamy (1985) and Kala Kannavar and Shashidar (1989).

Electrical conductvity of large size seeds was more than small seeds of both types of onion seeds.

Karivaratharaju et al. (1982) in redgram, Dharmalingam (1982) in mungbean reported higher EC values in large size seeds. The relative increase in leaching of inorganic and organic substances might be due to degree of soundness of membrane and larger area of the seeds for absorption of water.

The results clearly revealed superiority of seed quality of large size seeds when compared to small size seeds.

Seeds have to be stored in good storage structure where loss of viability is minimum. It should be remembered that, even if seeds are kept insect free, loss of viability takes place. Therefore it is essential to know the relative storage ability of different crop seeds and factors responsible for seed deterioration in the local prevailing conditions.

Onion seed is one of the shortest lived of all vegetable seeds. The present research was conducted to evaluate the storability of seeds as influenced by seed size, seed treatment and storage container under ambient conditions.

The moisture content of bellary and aggregatum onion seed increased with the increase in period of storage. But increase was minimum in small size seeds treated with fungicide and stored in polyethylene bags, on the other hand untreated seeds stored in cloth bag registered higher moisture percentage. But the difference between large and small size seeds was not significant. Vijayakumar (1987) and Agrawal (1980) recorded an increase in moisture content with increase in period of storage of onion seed. Seeds stored in polyethylene bags recorded relatively low moisture content with increase in period of storage as reported by Lall (1982).

In the present investigation, the seeds treated with Thiram maintained higher germinability (68 and 56 % in Bellary and Aggregatum, respectively) for longer period, than the control. This was in conformity with the results of Jacqueline (1988) in brinjal and Vijakumar (1991) in bellary onion. The large size seeds performed better in possessing longer viability than small seeds. Similar results were reported by Jayabarathi (1982) in soybean, Palanisamy (1990) in tomato and Balamurugan (1993) in sunflower. The maintenance of higher germination of seed stored in polyethylene bag might be attributed to its ability to permit only some ingress of moisture at high temperaure, where as in cloth bag the moisture exchange was quite frequent (Harisingh and Gurmit Singh, 1989). Seeds with higher moisture content favour the growth and development of various species of storage fungi belonging to the **Aspergillus** and **Penicillium** genera thereby causing loss of viability in cloth bags (Singh, 1990). In the present study, seeds treated with Thiram and stored in polyethylene bag maintained higher root and shoot length and vigour index than their counterpart untreated seeds stored in cloth bag. Similar results have been reported by Vijayakumar et al., (1987). Large seeds have shown superior performance in respect to germination with normal seedling and storability (Hussaini et al., 1984).

Seed deterioration in different RH levels

The environment plays a leading role in the production of quality seeds and its maintenance. In nature various factors like relative humidity, temperature and moisture interact in a complex manner affecting the quality of seeds. In onion seed, deterioration is promoted by high temperature and high RH (Vanangamudi et al., 1987). In the present study, the moisture content of seeds increased as the storage period increased. The moisture absorbtion was higher in seeds stored in high RH levels of 100 and 90 % followed by 75 and 50 %. Such increase in seed moisture due to different RH levels was reported by Vanangamudi et al., (1987) in onion and Halder and Gupta (1981) in sunflower.

In this study, as the moisture content increased, the germination of seeds decreased at all levels of RH in both bellary and aggregatum onion seeds. Similar results were reported by Harrington (1972), Sharma et al., (1985) and Vanangamudi et al., (1987). With the progressive period of storage, the germination of seed in all RH levels decreased. Halder and Gupta (1982) reported that at high RH levels the deterioration of seeds was very quick.

According to Christensen and Kaufman (1968) the seed moisture above 13 % causes heating and fungal invasion can quickly destroy the viability. At high moisture and temperature the metabolic activity and incidence of pest and diseases will increase resulting in death of seed (Doijode, 1985).

The vigour parameters of seeds as measured by root and shoot length, dry matter production and vigour index decrease as the period of storage advanced, similar results were obtained by Vanangamudi et al., (1987). Under low RH level the vigour of seeds was maintained steadily with minimum loss throughout the period of storage. The seeds stored at high RH levels lost its viability and vigour very quickly. Decline in germinability and vigour of seeds may be due to pathogenicity at high RH levels as reported by Halder and Gupta (1982).

In the present study, under high RH, there was steady increase in the electrical conductivity indicating disintegrity and breakdown of cell membrane. However, under low RH, there was no much variation in the electrical conductivity. Similar results were obtained by Halder and Gupta (1982) in sunflower. Doijode (1985) reported increase in electrical conductivity or leachate is directly proportional to the ageing of seeds, under high RH and temperature due to production of free radical induced membrane lipid damage (Robert et al., 1980).

The seed deterioration is normally promoted by the high RH and temperature experienced in storage environments. Accelerated ageing is the best method to evaluate relative storability of onion seeds (Doijode, 1990). Accelerated ageing resulted in reduced germination and vigour (Givelberg et al., 1984). In the present study, the increase in the period of ageing resulted in reduction of germination, seedling length and vigour of bellary onion seeds. The extended period of ageing resulted in greater decline in germination and seedling growth as indicated by Wu (1977) and Pesis and Ng (1983). Doijode (1989) reported reduction in all quality and vigour parameters of accelerately aged bottle gourd seeds. The loss in vigour of seeds might be due to impairment of cell membrane.

Senescence pattern of seed after accelerated ageing

The tetrazolium test has been used to trace bellary onion seed senescene@pattern of embryo in acceleratedly aged seeds. The staining pattern of seeds revealed that deterioration started from the root apex, shoot apex and progressed towards the adjoining mesocotyl region. Similar results were reported by Banerjee (1988). The present investigation revealed that for maintenance of viability, some group of key cells are important and when gets affected by unfavourable environment, it reached a stage of no-return and resulted in no germination of seeds. The investigation showed that mesocotyl region including root and shoot meristems seemed to be the most vital 'Key tissue' in onion seeds for maintaining viability. The result was in conformity with those of Purkar and Negi (1982) in peas and wheat.

Control of seed deterioration by Hydration-Dehydration treatment.

Hydration-dehydration treatment given to two months old seeds of bellary and aggregatum, exhibited maintenance of viability after and subsequent period of storage Similar results were obtained by Doijode and Raturi (1987), Palanisamy and Karivaratharaju, (1992), Penaloza and Eira (1993) and Balamurugan (1993). Hydration - dehydration treatments effectively slowed down the physiological deterioration. The increased germination of 90 % from 87.5 % and maintenance of vigour after treatment might be due to better membrane integrity and reduced lipid peroxidation, whereas, Chouduri and Basu (1968) reported that increased maintenance of viability could be due to reduced leaching of sugars, amino acids and greater dehydrogenase activity.

In the present investigation, treated seeds showed increased seedling length, vigour and dry matter production of seedlings. These results are in agreement with the results obtained by Doijode and Raturi (1987) in several vegetable seeds (Radish, cluster bean, onion, tomato and garden peas), Veeraragavatham (1990) in papaya and Thorton and Powell

(1992) in **Brassica oleraceae.** There was clear evidence that as the period of storage increased storability reduced in untreated seeds, whereas, treated seeds maintained its viability and vigour even at the end of the storage period. Bandyopadhayay et al., (1982) reported response of treated seeds due to biochemical repair mechanism and also on the basis of a possible counteraction of free radical pathology.

Hydration - Dehydration treatment on productivity

The beneficial effects of hydration - dehydration treatments were manifested in increased bulb yield to an extend of 7-12 and 19 % in the treated seeds of bellary and aggregatum onion respectively. The significant beneficial effect of hydration - dehydration treatments on productivity confirmed the earlier findings of Dharmalingam (1982), Balamurugan (1993) in sunflower and mungbean. Mitra and Basu, (1979), Bandhyopadhayay et al. (1982) in Jute, Kundu and Basu, 1981, Singh et al. (1982), Dharmalingam and Basu (1988) and Balamurugan (1993). Doijode (1987) reported that hydration - dehydration of onion seeds gave good stand establishment of seedlings resulted in increased yield over control. The other possible reasons were, treated seeds have found to be greater dehydrogenase activity and apprecially lower lipid peroxide formation in cells.

Summary

CHAPTER VI

SUMMARY

Studies were conducted at the Department of Seed Technology, Tamil Nadu Agricultural University, Coimbatore with the seeds of bellary onion cv. Nasik red and aggregatum onion cv. Mutlur local to elicit information on the quality of seeds by size grading, storage of seeds under ambient as well at different RH levels, pattern of deterioration and Hydration - Dehydration treatments on the maintenance of viability and vigour as well as productivity.

The bellary onion seed lot constituted mostly of large size seeds accounting for 82.0 % and the small seeds 14.0 % of the total seed weight. The aggregatum onion seed lot constituted above 69 and 22 % of the large and small size seeds, respectively.

The seed weight varied with the size grade. The 100 seed weight was more for large seeds of both onion types than medium and small size seeds.

The germination potential, seedling growth and vigour index of large seeds of both onions were significantly higher than those of medium and small size seeds.

Electrical conductivity of seed leachate was more for large than small seeds. Bellary onion seeds registered higher values than aggregatum onion.

The storability of onion seeds was influenced by fungicide treatment, size of seeds and type of containers. The large size seeds of both bellary and aggregatum treated with Thiram and stored in 700 gauge polyethylene bags registered 68 and 56 % respectively after 8 months of storage under ambient conditions.

The large size seeds stored in cloth bag without seed treatment absorbed more moisture during storage than treated seeds stored in polyethylene bags and lost the viability more quickly.

The vigour in terms of root and shoot length and dry matter production of large sized seeds was superior to those of small seeds.

The relative humidity enhanced the deterioration of seeds. The seeds of both onions stored at 100, 90, 75 and 50% RH levels revealed that the deterioration of seeds was much faster at 100 % RH due to invasion of several saphrophytic fungi. With progressive increase in the storage period, the germination, seedling length, dry matter production and vigour index decreased while the moisture content of seeds increased at all RH levels. However, seeds stored at 50 % RH, the rate of deterioration was minimum.

The accelerated ageing test was found to be a better tool to evaluate the relative storability of seeds. With the ageing duration there was greater reduction in germination, root and shoot length, dry matter production and vigour index.

The senescence pattern of the seeds indicated that root and shoot apex including mesocotyl regions are the most vital 'Key tissue' in bellary onion seeds. In ageing, the deterioration started from the root and shoot apex and progressed towards the adjoining mesocotyl region.

The two-months old seeds of bellary and aggregatum onions when subjected to hydration - dehydration treatment with dilute solution of disodium phosphate (10^{-4}M) for two and half hours maintained their viability and vigour in storage.

The hydration and dehydration treatment given to 5 month old seeds gave highest yield in both the onions when compared to 6 and 7 month old seeds. There was no significant difference in the height of the plant irrespective of types of onion and age of seeds.

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