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Effect of Gibberellic Acid, Ethephon and their Combination on Vegetative Growth, Bulb Size and Yield of Onion (*Allium cepa* L.)

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सारांश

प्याज की वानस्पतिक वृद्धि, कन्द आकार एवं उपज पर जिब्रेलिक अम्ल (0, 10, 20 एवं 30 पी.पी.एम.) एवं इथेफोन (0, 1000, 2000 एवं 3000 पी.पी.एम.) के विभिन्न सान्द्रता के संयोजनों के प्रभाव का अध्ययन किया गया। परिणाम दर्शाते हैं कि अन्य उपचार संयोजन की तुलना में जिब्रेलिक अम्ल 30 पी.पी.एम. एवं 0 पी.पी.एम. इथेफोन उपचार संयोजन से उपचारित करने पर अधिकतम पौधे की लम्बाई (61.42 से.मी.) प्रति पौधा पत्तियों की संख्या (10.8) ग्रिवा पर कन्द व्यास (1.62 से.मी.) एवं संख्या में औसत बोल्टेड पौधे (3.0) पाये गये। अन्य उपचार संयोजनों की तुलना में इसी उपचार संयोजन से ताजा कन्द भार (106.2 ग्राम), सूखा कन्द भार (79.12 ग्राम) कन्द व्यास (5.52 से.मी.) ग्रिवा पर कन्द व्यास (0.911 से.मी.) एवं प्रति प्लाट उपज (6.17 कि.ग्रा.) पर सार्थक अभिवृद्धि पायी गयी।

Onion is widely grown as vegetable crop and ranks first in acreage and production among bulbous vegetable crops. India inspite of being a major onion producing country has very low yield of about 10.6 tonnes per hectare as campared to 47.2 tonnes per hectare in Netherland and 42.2 tonnes per hectare in Japan, (Anon. 1). Increase in yield of vegetable crops has been obtained through use of improved vegatable varieties, efficient use of chemical fertilizers and various agronomical practices. Besides, growth regulating chemicals are also becoming important in increasing the yield of vegetables including onion. Their use if adopted, can benefit the farmers and consumers both with respect to production and income. Levy and Kedar (6) and Levy *et al.*, (7) found that ethephon promoted early and rapid bulb growth. Effect of ethephon have also been reported by Lipe (9), Thomas and Rankin (13) in onion. Lipe (8) has also reported that in onion GA_3 increased

the number of leaves per plant. A number of workers have studied the response of GA on plant growth and yield of different vegetaqle crops (Maurya and Lal (10) in onion, Maurya *et al.*, (11) in bhindi and Hore *et al.*, (4) in onion). The purpose of the present study was to evaluate the effect of different levels of GA, ethephon and their combinations on vegetative growth, bulb size and yield of onion.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture farm, Rajasthan College of Agriculture, Udaipur, from November, 1988 to April, 1989. The soil of the experimental field was clay loam with good water holding capacity. The pH of the soil was 8 and EC was 0.32 mmhos/cm. The treatments consisted of all combinations of four levels of gibberellic acid (0, 10, 20 and 30 ppm) and four levels of ethephon (0, 1000, 2000 and 3000 ppm). Thus, there were 16 treatment combinations in the experiment. The nursery beds of 1.5 x 1.0 m were prepared by mixing well rotten FYM in the soil @ 10 kg per bed. Seeds of onion cv. Udaipur-101 were treated with captan @ 2 g per kg seed and sown in nursery beds on November 8, 1988. The experiment was laid out in a 'Randomised Black Design' with three replications. Seedlings were transplanted in the field on 27th December, 1988, i. e., when they were 50 days old, at a spacing of 15 X 15 cm and thus, there were a total of 130 plants per plot (2.0 X 1.5 m). The crop was sprayed at 4, 6 and 8 leaf stage by respective treatment combinations. While spraying, 1 ml of teepol per litre of growth regulator solution was added to act as a sticking agent. Spraying of growth regulator was started at 4 leaf stage and then periodical observations on vegetative growth characters were recorded at an interval of 10 days in 10 plants per treatment, which were randomly selected and tagged. Final observations on plant height, number of laves per plant, diameter of bulb at neck, and average number of bolted plants per plot were recorded when 75 per cent top leaf were druped. Maturity of the crop also found by counting number of days from date of transplanting to date of 75 per cent top leaf fall stage. Ten tagged plants in each treatment were harvested separately and used for recording fresh weight of bulb, weight of bulb after curing, diameter of bulb, neck thickness and yield per plot, was also recorded.

RESULTS AND DISCUSSION

The interaction effect of different concentrations of GA and ethephon were found significant with regards to vegetative growth and yield characters. The G_3E_0 treatment

combination was found to be the best with regards to maximum plant height (61.42 cm), number of leaves (10.8), diameter of bulb at neck (1.62 cm) and the average number of bolted plants (3.0). With respect to yield attributes the G_3E_0 combination recorded maximum fresh weight of bulb (106.20g), cured weight of bulb (79.12g), diameter of bulb (5.52 cm), neck thickness (0.91 cm) and yield (6.178 kg/plot). These were found significantly better than the other combinations and control. The treatment combinations G_2E_0, G_1E_0 and G_3E_1 were also superior with respect to growth and yield than control. The treatment combination G_3E_0 was far better than rest of the treatment combinations because in this combination only GA 30 ppm was applied. It means that all the improvement in vegetative growth and yield characters might be due to GA 30 ppm. An increase in plant height might be on account of the fact that GA promoted vegetative growth by inducing active cell division and cell enlargement. Another possible reason for the increased plant height may be due to increased osmotic uptake of water and nutrients under the influence of GA which maintains a swelling force against the softening of cell walls and thereby increasing plant height. The possible explanation for an increase in the number of leaves per plant might be due to increased vegetative growth by increased photosynthetic activity, accelerating metabolic transport and utilizing efficiently the photosynthetic products of GA application. Thus, the number of leaves per plant seems to have increased by new leaf initiation and expansion. The increase in the number of leaves per plant may be attributed to the ability of chemical to promote more number of leaves at the early stage of development. The increase bulb size and weight by the same treatment might be due to fact that GA increased plant height, the number of leaves, resulting in increased photosynthetic activity of the plant and ultimately higher dry matter production. These results are in close confirmation with the findings of Jauhari *et al.*, (5) in spinach ; Lipe (8) and Hore *et al.*, (4) in onion. The increase in bulb weight might be accounted to the findings of Heath and Holdsworth (3) who stated that the development of bulb of onion is not due to apparent cell division but growth is simply by swelling of leaf cells already there. GA at lower concentrations increased vegetative growth but at higher doses it induced bolting and enhanced flowering. This finding was on similar line as observed by Corgan and Montano (2) in onion, and Salesh and Abdul (12) in tomato.

Ethephon application might be helpful in earliness in maturity of the crop but all other characters related to vegetative growth and yield have declined as the concentrations

of ethephon increased. The reduction in plant height might be due to antigibberellin action of ethephon and when it was applied, it must have negated the endogenous GA levels, thereby activities like apical growth, cell elongation and cell growth might have inhibited, resulting in reduction in plant height. Decreased leaf number might be due to suppression of plant height by ethephon application which in turn resulted in cessation of leaf initiation after certain period of growth. The earliness in maturity of crop by the ethephon application might have been due to suppression of vegetative growth, earlier bulb initiation and bulb maturity. The decrease in size and weight of onion bulbs might be due to restrictive growth, less nutrient conceptions and other effects for which the ethephon could be directly responsible. The reduction in bulb size might be due to inhibition of plant height and production of less number of leaves by ethephon application. This might have caused poor vegetative growth of the plants resulting in low carbohydrates synthesized by the plants subsequently reducing the bulb size and weight and thereby total yield. The results of ethephon on vegetative growth and yield characters are in agreement with the findings of Levy and Kedar (5), Corgan and Montano (2), Lipe, (8), and Thomas and Rankin (13) in onion.

SUMMARY

The effect of different concentrations of GA (0, 10, 20 and 30 ppm) and ethephon (0, 1000, 2000 and 3000 ppm) combinations on vegetative growth, bulb size and yield of onion were studied. The results show that G_3E_0 treatment combination (30 ppm GA + 0 ppm ethephon) produced maximum plant height (61.42 cm), number of leaves per plant (10.8); diameter of bulb at neck (1.62 cm) and the average of bolted plants (3.0), over all other treatment combinations. The same treatment combination significantly, increased the fresh weight of bulb (106.2g) cured weight (79.12g) diameter of bulb (5.52 cm) diameter of bulb at neck (0.91 cm) and yield 6.17 kg/plot (205.9 q/ha) over all other treatments. Whereas, ethephon separately or in combination with GA significantly reduced vegetative growth and yield characters.

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Table-1 : Effect of GA and ethephon combination on vegetative growth, bulb size and yield of onion

Treatment Combination	Vegetative growth characters					Yield characters					
	Plant height (cm)	No. of leaves/ plant	Diameter of bulb at neck (cm)	No. of bolted plants	Time taken for maturity (days)	Fresh weight of bulb (g)	Bulb weight after curing (g)	Diameter of bulb (cm)	Bulb neck thickness (cm)	Yield per plot (kg)	Yield (Q/ha)
G_0E_0	47.62	7.8	1.303	5.0	106.6	47.12	32.12	3.15	0.465	3.250	108.3
G_0E_1	44.44	7.8	1.300	4.0	104.3	42.08	31.08	3.13	0.471	3.235	107.8
G_0E_2	49.35	7.6	1.291	4.0	102.6	40.47	30.74	3.12	0.475	3.225	107.5
G_0E_3	45.96	7.2	1.280	3.0	101.3	38.09	30.10	3.11	0.481	3.220	107.3
G_1E_0	53.90	9.2	1.477	3.0	107.3	81.21	60.17	3.10	0 812	5.161	172.0
G_1E_1	48.65	8.7	1.404	4.0	107.0	76.42	57.00	4.82	0.789	4.892	163.0
G_1E_2	45.83	8.0	1.333	17.0	106.6	68.23	50.12	3.92	0.649	4.600	153.0
G_1E_3	47.77	8.0	1.260	5.0	105.6	58.36	38.15	3.41	0.518	4.110	137.0
G_2E_0	58.60	10.1	1.560	3.0	109.3	92.97	70.86	5.20	0.878	5.621	197.3
G_2E_1	54.35	8.7	1.400	3.0	108.6	78.35	58.25	5.06	0.801	5.010	166.0
G_2E_2	50.41	8.4	1.361	21.0	109.3	73.32	54.57	4.33	0.712	4.770	159.0
G_2E_3	47.32	7.8	1.327	9.0	107.6	56.47	40.35	3.51	0.538	4.170	139.0
G_3E_0	61.42	10.8	1.623	3.0	112.6	106.20	79.12	5.52	0.911	6.178	205.9
G_3E_1	58.30	8.9	1.432	4.0	110.6	90.95	69.17	5.21	0.872	5.610	187.0
G_3E_2	52.13	8.3	1.290	4.0	109.0	72.34	55.12	4.74	0.712	4.792	159.7
G_3E_3	49.72	8.3	1.348	12.0	108.3	62.63	45.40	3.55	0.610	4.440	148.0
CD at 5% G	1.69	0.50	0.041	1.88	0.74	3.53	0.98	0.11	0.016	0.143	
E	1.69	0.50	0.041	1.88	0.74	3.53	0.98	0.01	0.016	0.143	
G x E	3.38	NS	0.083	3.77	1.49	7.06	1.97	0.22	0.033	0.486	