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# EFFECT OF NITROGEN AND BIO-FERTILIZER ON YIELD AND QUALITY OF *RABI* ONION (*ALLIUM CEPA* L) CV. PUNA RED

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## ABSTRACT

**A field experiment was conducted on sandy loam soil during *rabi* season of 1999-2000 to study the effect of four levels of nitrogen (25, 50, 75 and 100 kg ha$^{-1}$) and two sources of bio-fertilizer *viz.*, *Azotobacter* ($A_1$) and *Azospirillum* ($A_2$) on yield and quality of onion bulb (*Allium cepa* L). Results indicated that the application of nitrogen @100 Kg N ha$^{-1}$ significantly increased bulb yield and quality attributes. The treatment combination $N_4A_1S_2$ (100 kg N ha$^{-1}$ + *Azotobacter* with seedling dipping) gave highest bulb yield and fresh weight of bulb, followed at par by $N_3A_1S_2$ (75 Kg N ha$^{-1}$ + *Azotobacter* with seedling dipping). In economics, the maximum B:C ratio (2.26:1) was recorded with the treatment combination of $N_3A_1S_2$ as compared to $N_4A_1S_2$ with a lower B:C ratio (2.24:1) due to additional cost of urea and non significant difference between these two treatments regarding yield of bulbs. Thus, the treatment combination $N_3A_1S_2$ was the best.**

Onion (*Allium cepa* L) is one of the most important vegetable crops commercially grown through out the world. India has the largest area (0.42m ha) under onion cultivation in the world and it is the second largest producer (4.76 mt) of onion bulbs, but the yield per unit area (10.5 t ha$^{-1}$) is very low in comparison to other developed countries (Anonymous, 2000). Onion bulbs are rich in minerals like calcium (180 mg/100g) and phosphorus (50 mg/100g) and vitamin 'C' (11mg/100g) (Aykroyd, 1963). It is also used as salad and cooked in various ways to prepare different kinds of dishes.

Bio fertilizers are the inoculation of micro-organism, which are capable of converting nutritive elements from non usable form to usable form through biological process. They are cost effective and inexpensive source of plant nutrients, do not require non-renewable source of energy during their production, improve crop growth and quality of the product by providing plant hormones and help in sustainable crop production through maintenance of soil productivity (Bhonde *et al.*, 1997 and Dibute *et al.*, 1993).

The investigations were conducted at the Horticulture farm, S K N College of Agriculture, Jobner under semi-arid condition during 1999-2000. The experiment was laid out in a split-plot design with four replications. There were twenty four treatment combinations comprising of four levels of nitrogen i.e., 25 ($N_1$), 50 ($N_3$) ,75 ($N_3$) and 100 ($N_4$) kg nitrogen ha$^{-1}$, three treatments of *Azotobacter* ($A_1$) *viz.*, seedling dipping, seed and soil application ($A_1S_1$, $A_2S_2$ and $A_1S_3$) and three treatments of *Azospirillum* ($A_2$) i.e., seedling dipping ($A_2S_1$), seed ($A_2S_2$) and soil application ($A_2S_3$), The seedling were transplanted on 12$^{th}$ January. The plant to plant spacing (10 cm) was uniform for ail the treatments. The net plot size was 3 x 1.8m. The nitrogen was applied as per treatment through urea, half as basal dose and remaining half in two equal split at 30 and 50 days after transplanting. *Azotobacter and Azospirillum* were applied as 2 kg culture in 50 litres of water as seedling dipping and 2 kg culture was mixed with 20 kg FYM as soil application while, seed treatment with *Azotobacter* was made by 2 kg culture mixed with 2 kg jaggery and in case of *Azospirillum* 2 kg culture was mixed in 2 litres boiled rice water for one hectare application. All the recommended cultural

**Table 1.** Effect of nitrogen and bio-fertilizer on onion yield and quality attributes

| Treatments | Fresh weight of bulb (g) | Bulb yield (q ha$^{-1}$) | N content in bulb (%) | S content in bulb (%) | TSS (%) | Pungency (allylpropyl disulphide) (mg/100g) |
|---|---|---|---|---|---|---|
| **Nitrogen** | | | | | | |
| $N_1$ | 30.42 | 171.66 | 0.718 | 0.655 | 8.28 | 6.45 |
| $N_2$ | 35.35 | 199.02 | 0.805 | 0.671 | 9.52 | 6.53 |
| $N_3$ | 39.77 | 239.56 | 0.872 | 0.680 | 10.65 | 6.59 |
| $N_4$ | 43.04 | 251.20 | 0.918 | 0.689 | 11.07 | 6.63 |
| Sem± | 1.01 | 3.23 | 0.010 | 0.013 | 0.151 | 0.02 |
| C.D. at 5% | 3.22 | 10.34 | 0.032 | N.S. | 0.484 | 0.12 |
| **Bio-fertilizer** | | | | | | |
| *Azotobacter* | | | | | | |
| $A_1S_1$ | 35.27 | 210.09 | 0.828 | 0.676 | 9.88 | 6.65 |
| $A_1S_2$ | 42.13 | 231.51 | 0.834 | 0.682 | 10.06 | 6.59 |
| $A_1S_3$ | 35.19 | 206.31 | 0.862 | 0.667 | 9.86 | 6.53 |
| *Azospirillum* | | | | | | |
| $A_2S_1$ | 35.10 | 209.36 | 0.827 | 0.674 | 9.84 | 6.53 |
| $A_2S_2$ | 41.26 | 230.31 | 0.831 | 0.680 | 9.94 | 6.58 |
| $A_2S_3$ | 34.02 | 204.76 | 0.823 | 0.663 | 9.75 | 6.52 |
| Sem± | 0.81 | 2.63 | 0.011 | 0.008 | 0.03 | 0.076 |
| C.D. at 5 % | 2.30 | 7.46 | N.S. | N.S. | 0.09 | N.S. |

NS= Non-Significant.

operations were followed to raise a healthy crop.

**Effect of nitrogen:** Various levels of N showed significant affect on yield, yield attributes and quality of onion crop (Table 1) except sulphur content of bulbs. Significantly higher fresh weight of bulb (43.04g), bulb yield (251.20 q ha$^{-1}$), N content (0.918%), TSS (11.07%) and pungency (6.63mg/100g) were recorded under $N_4$ as compared to control . This might be due to the fact that nitrogen has helped in vigorous vegetative growth and imparted deep green colour to the foliage which favored photosynthetic activity of the plants so there was greater accumulation of food material i.e., carbohydrates in the bulb which ultimately resulted in more synthesis of TSS content. The similar results have also been reported by Singh *et al.* (1989) and El-Okesh *et al.* (1993). Bio-fertilizers application significantly influenced the bulb yield, fresh weight of bulb and TSS of bulb. The maximum bulb yield (231.51 q ha$^{-1}$), fresh weight of bulb (42.13g) and TSS (10.06%) were recorded under $A_1S_2$ treatment of bio-fertilizer followed by $A_2S_2$. It is unequivocal that bio-fertilizers produce anti fungal antibiotic substances that inhibits various of soil fungi. It can also synthesize and secrete thiamin, riboflavin, cyanocobalamine, nicotinic acid, pentothenic acid, indole acetic acid and gibberellins like substances resulting in vigorous plant growth and dry matter production which in turn resulted in better fertilization, bulb development and ultimately the higher yield, besides these it colonizes the root mass, fixes nitrogen in loose association with plants and these bacteria induce the plant root to secrete a mucilage which create low oxygen involvement and helps to fix atmospheric nitrogen which refrated in the better yield attributes. Similar results have also been reported by Joi and Shende (1976), Dibute *et al.* (1993) and Bhonde *et al.* (1997).

**Interaction effect of N x bio-fertilizer on yield:** The data pertaining to the inter-active effect of N x bio-fertilizer on bulb yield are

**Table 2.** Interaction effect of Nx bio-fertilizer on bulb yield of onion bulb

| Nitrogen (kg ha$^{-1}$) bio-fertilizer | $N_1$ bulb yield (q/ha) | Fresh weight of bulb (g) | $N_2$ bulb yield | Fresh weight of bulb | $N_3$ bulb yield | Fresh weight of bulb | $N_4$ bulb yield | Fresh weight of bulb | Mean of bulb (q/ha) | Fresh weight of bulb |
|---|---|---|---|---|---|---|---|---|---|---|
| $A_1S_1$ | 174.93 | 30.77 | 195.63 | 33.34 | 226.50 | 36.49 | 243.30 | 40.48 | 210.09 | 35.27 |
| $A_1S_2$ | 177.58 | 31.28 | 210.09 | 40.29 | 268.85 | 47.81 | 269.52 | 49.14 | 231.51 | 42.13 |
| $A_1S_3$ | 164.62 | 30.60 | 192.87 | 33.59 | 225.24 | 35.76 | 242.51 | 40.41 | 206.31 | 35.09 |
| $A_2S_1$ | 173.76 | 29.98 | 195.16 | 33.14 | 225.99 | 37.09 | 242.53 | 40.19 | 209.13 | 35.10 |
| $A_2S_2$ | 176.22 | 30.55 | 208.46 | 39.55 | 267.68 | 46.63 | 268.16 | 48.31 | 230.13 | 41.26 |
| $A_2S_3$ | 162.85 | 29.34 | 191.91 | 32.19 | 223.10 | 34.84 | 241.18 | 39.71 | 204.76 | 34.02 |
| Mean | 171.66 | 30.42 | 199.02 | 35.35 | 239.56 | 39.77 | 251.20 | 43.04 | | |

| | Bulb yield | Fresh weight of bulb |
|---|---|---|
| SEm± for N | 3.23 | 1.01 |
| SEm± for biofertilizer | 2.63 | 0.81 |
| SEm± N x biofertilizers | 5.80 | 1.80 |
| CD for N at 5% | 10.34 | 3.22 |
| CD for bio-fertilizer at 5% | 7.46 | 2.3 |
| CD for N x bio-fertilizer at 5% | 17.08 | 5.23 |

presented in Table 2. Significantly maximum fresh weight of bulb (49.14g) and bulb yield (269.52 q ha$^{-1}$) were obtained with $N_4A_1S_2$ followed by $N_4A_2S_2$, $N_3A_1S_2$ and $N_3A_2S_2$ which were at par with each other. It might be due to the synergistic effect of nitrogen and bio-fertilizers on yield parameters. This indicates that both the treatments were significant and exhibited the complementary effect of one on the other in augmenting the efficiency of bio-fertilizers with nitrogen. These results are in close conformity with the findings of Joi and Shinde (1976),they advocated that when onion seedlings dipped in *Azotobacter* slurry for about 30 minutes before transplanting + 100 kg N ha$^{-1}$ produced the highest yield of onion as compared to other treatments. Similar results were also obtained by Warade *et al.* (1996) and Bhonde *et al.* (1997). Although, the maximum yield of onion ha$^{-1}$ was recorded under $N_4A_1S_2$ but B:C ratio was lower as compared to $N_3A_1S_2$ due to the additional cost of urea. Thus, the treatment combination of 75 kg N ha$^{-1}$ + *Azotobacter* with seedling dipping ($N_3A_1S_2$) was the best in the present investigation.

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