The Pharma Innovation Journal 2021; 10(11): 1030-1033

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 1030-1033

www.thepharmajournal.com
Received: 13-09-2021
Accepted: 21-10-2021

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Effect of major nutrients (nitrogen, phosphorus and potassium) on yield and quality of rainy season onion (*Allium cepa* L.) raised from seedling

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Abstract
An investigation was carried out at the vegetable research farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during *rainy season* of 2018 and 2019. The soil of the experimental field was sandy-loam with uniform topography**.** A field experiment was conducted to determine the N, P and K rates for yield attributes i.e. total yield, diameter of bulb, double bulb, bolting percentage neck thickness and T.S.S. as quality parameters of onion. A factorial combination of three rates of N (50,100 &50 kg /ha), two rates of P (40 & 80 kg/ ha) and potash two level (50 &100 Kg/ha) were used for the experiment. Treatments were laid down in a Randomized Complete Block Design (RCBD) in a factorial combination with three replications. Two years trial with Cv. Agrifound Dark Red and results of this study revealed that the application of nitrogen showed significant effect in most of studied characters. Higher levels of nitrogen increased the yield significantly over all the treatments. Different levels of phosphorus and potassium did not affect the quality parameters of onion. Phosphorus and potassium did not show any significant alteration on yield and yield attributes and quality. The application of 150 kg N +80 kg P2O5 +100 Kg K2O/ ha was most appropriate combination of nutrients with respect to yield and quality of the rainy season onion crop propagated through seedling.

Keywords: Onion, yield, quality, nitrogen, phosphorus, potash

Introduction
Onion is commercially cultivated in India for both vegetable and spices purpose. India ranks second in area and production in the world after China and third in export after the Netherland & Spain. Onion is one of the most ancient food sources on the planet. Since the beginning of civilization, onions have been an important part of our diet. Onion is a very good source of vitamin C, B6, biotin, chromium, vanadium, calcium and dietary fibre. In addition, it contains a good amount of folic acid and vitamin B1 and K. The onion smell and taste are important diagnostic features of the genus *Allium.* Other characteristics include the presence of bulbs formed by the attachment of swollen leaf bases to the underground part of the stem and inflorescence in the form of umbels with numerous small flowers. The pungency in onion is due to volatile oil as *allyl-propyl disulphide* ($C_6 H_{12} S_2$). The colour of the outer skin of onion bulbs is due to *quercetin*. Once believed to be a lowly vegetable because of its pungent taste, onion has emerged as a favorite ingredient in many recipes. Onion is an important and indispensable item and can be found in almost every kitchen around the world. It is popularly used at both immature and mature bulb stages as vegetable. Among the many constraints for low productivity in onion, imbalanced nutritions are main limiting factors. Continuous and imbalanced uses of fertilizers are adversely affecting the sustainability of agricultural production besides causing environmental pollution. Adequate fertilization is one of the potential agronomic practices for boosting production of *kharif* onion. Onion produced in India are either consumed as raw vegetable or as condiment. Successful cultivation of any crop depends upon climate, soil type, cultural practices, fertilizers and soil moisture etc. A crop of 40 t/ha removes approximately 120 kg of N, 50 kg of P_2O_5 and 160 kg of K_2O per ha**)** (Tandon and Tiwari, 2008) [1]**.** It has been reported that for a yield of 30 tonnes of onion per hectare, the crop remove 65 kg N, 42 kg P_20_5,and 130 kg of K_2O (Pandey1989) [2]. The gross yield as well as fertilizer requirement of rainy season onion production is thus a new strategy in north India. However, unlike, the *rabi* onion crop, very little information is known about the production technology of this crop also.

Materials and Methods

The investigation was under taken at C.S. Azad university of Agriculture and Technology during rainy season of 2018-19 and 2019-2020. The soil of the experimental field was sandy loam. The treatment consisted of three levels of nitrogen (50,100 and 150 kg/ha) with twelve treatment combination. The treatment were replicated three times in a factorial randomized block. Just before transplanting of seedling P_20_5 and K_2O as super phosphate and murate of potash respectively were broadcast and hoed in to soil. Nitrogen in the form of urea was applied in three equal doses i.e. 1/3 at transplanting second application 30 days after transplanting and third 60 days after transplanting. Pendimethalin @ 6 ml/l was applied as a pre-emergence herbicide to prevent the initial weed growth and hand weedings were carried out as and when necessary. Spray of insecticide (Imidacloprid @ 0.5 ml/l of water) and fungicide (Copper oxychloride @ 2g/l of water) was also done at intervals of 15 days of transplanting for protection of crop from insect pest and diseases. Agrifound Dark Red variety was selected for this study. Eight week old seedling of this variety were transplanted on 2nd week of august during the year 2018 and 2019 respectively. The spacing of 15×10 cm were kept in each plot of 1.5×1.0 m. Observation were recorded on six important characters *viz.*, total yield (q/ha), neck thickness (cm), bolting bulb (%), doubling of bulb, diameter of bulb (cm) and T.S.S. for each treatment. Five plants were observed at random for recording yield and quality characters. The crop was harvested at full maturity stage and yield per treatment wise were recorded. Neck thickness, of 6 bulbs in each treatments selected randomly and measured with the help of vernier caliper after harvesting. Data on quality characters were recorded just after harvesting. Total soluble solid were determined with hand refractometer**.**

Results and Discussion

Effect of nitrogen

Data given in Table- 1 indicated that N had significantly affected the total yield of onion after harvesting. The bulbs were sorted out into marketable and unmarketable grades. The data reveal that application of N at a rate of 150 kg/ha increased the total yield in both the year. In second year total yield is higher (389q/ha) than first year (325.30 q/ha). Higher dose of nitrogen gave maximum weight of marketable and unmarketable bulb yield. Probably higher dose of nitrogen increased the weight of individual bulbs. However, the total yield of onion bulb increased nearly with increasing levels of nitrogen in both the rainy seasons. Since nitrogen is essential for building up of protoplast and proteins, which induce cell – division and initiate meristematic activities. (Randhawa and Singh (1974) [3], Henriksen (1987) [4] and Birhanu Messele (2016) [5]. Diameter of bulb obtained maximum through application of N 150 Kg/ha in both the years. This result was in agreement with the findings of Nasreen *et al*. (2016) [6]. However, non significant result in bolting of onion plants were also recorded in both the years due to increasing levels of nitrogen. It might be due to continuous growth leading to bulking and thereafter, to bulb development without giving any opportunity for formation of bolters, results obtained by the application of nitrogen on neck thickness (cm) and doubling of bulb. Jointed bulb indicated that the increasing levels of nitrogen had not any appreciable effect during 2018 on neck thickness and 2019 jointed double bulb. However, increasing levels of nitrogen showed significant responses in neck thickness during 2018 and jointed bulb during 2019. Result are in compelete agreement with finding of Hedge (1986) [7], Singh & Dhankar (1991) [8] and Pandey (1989-90) [9]. Data given in Table 1 revealed that significant changes were observed in T.S.S. content of bulb in both years. Maximum TSS obtained by application of N 50 kg/ha dose of nitrogen and minimum TSS given by N 150 kg /ha dose of nitrogen in both year.

Effect of phosphorus

Application of single super phosphate in various levels did not prove to be beneficial with regard to yield as well as yield attributes. Phosphorus application exhibited significant responses on T.S.S. and neck thickness of onion bulb during the year 2018. However, the same dose of phosphorus exhibited non-significant response during 2019. Significant responses in T.S.S. and neck thickness were observed due to higher dose of phosphorus application. Significant effects were observed on the percentage of double bulb due to the application of both the levels of phosphorus during both the years. The percentage of double onion bulb was maximum at higher dose of phosphorus (P 80 Kg/ha). The observations are in agreement with the findings of Singh and Singh (2001) [10]. Higher rainfall causes more exation of phosphorus and leaching of nitrogen and less availability of these nutrients to the plants and thus caused poor yield and vice –versa. These findings are in agreement with those reported in the annual report of AADF (Anon-1989-90) [11] for rainy season onion. (*Kharif* onion)

Effect of potassium

Use of potassium in the form of murate of potash at two levels i.e. 50 and 100 kg/ha did not affect significantly the yield attributing characters. Result indicate that neck thickness of bulb have been found significant during 2018. Total yield was also not affected significantly due to potassium application. The present findings are in agreement with the result reported by Satyanasayan and Arora (1984) [12]. The effect of potassium did not show any significant alteration on the T.S.S, doubles and bolting percentage of the bulb. Lower dose of potassium applied (50kg K_2O/ Ha), showed higher bolting percentage of bulb and the differences were non-significant. The observations are in agreement with Singh and Dhankhar (1991) [8].

Effect of interactions

All the yield attributes of onion plants remained unaffected by the combined use of N×P, P×K and N×P×K. The interaction effect of N×P, P×K and N×P×K did not show any significant alteration on the T.S.S., doubles and bolting, diameter and neck thickness of the bulb. The observations are in agreement with Botcher and Kolbe (1975) [13].

Table 1: Effect of N, P and K on total yield, diameter of bulb and neck thickness of bulb

Treatment	Total yield (q/ha)		Diameter of bulb (cm)		Neck thickness (cm)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Nitrogen level (Kg/ha)						
N 50	155.45	222.7	5.13	5.47	1.39	1.49
N100	254.03	301.34	6.27	5.77	1.66	1.64
N150	325.30	389.82	6.50	6.45	1.98	1.87
L.S.D. at 0.5%	61.90	68.08	0.37	NS	0.28	NS
Phosphorus level(Kg/ha)						
P 40	215.27	279.9	5.81	5.59	1.60	1.60
P 80	246.96	329.32	6.12	6.00	1.80	1.73
L.S.D.at 0.5%	NS	NS	0.30	NS	0.20	NS
Potash level (Kg/ha)						
K 50	228.10	290.24	5.91	5.79	1.62	1.62
K 100	234.13	329.00	6.02	6.00	1.73	1.73
L.S.D. at 0.5%	NS	NS	NS	NS	0.23	NS
Interaction						
N ×P	NS	NS	NS	NS	NS	NS
N ×K	NS	NS	NS	NS	NS	NS
P× K	NS	NS	NS	NS	NS	NS
N× P× K	NS	NS	NS	NS	NS	NS

Table 2: Effect of N, P and K on double, bolting (%) of bulb and T.S.S.

Treatment	Double bulb		Bolting Bulb		T.S.S.	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Nitrogen level (Kg/ha)						
N 50	12.49	14.47	3.73	3.58	12.05	11.97
N100	11.02	11.32	1.97	1.91	11.32	11.35
N150	10.98	8.92	0.69	1.25	10.56	10.85
L.S.D. at 0.5%	NS	1.55	NS	NS	0.63	0.85
Phosphorus level(Kg/ha)						
P 40	10.40	10.66	2.69	2.61	11.12	11.16
P 80	12.60	12.49	1.97	1.88	11.51	11.62
L.S.D.at 0.5%	2.14	1.27	NS	NS	0.52	NS
Potash level (Kg/ha)						
K 50	10.87	10.95	2.36	2.50	11.26	11.32
K 100	12.13	12.20	1.90	1.88	11.37	11.46
L.S.D. at 0.5%	NS	NS	NS	NS	NS	NS
Interaction						
N ×P	NS	NS	NS	NS	NS	NS
N ×K	NS	NS	NS	NS	NS	NS
P× K	NS	NS	NS	NS	NS	NS
N× P× K	NS	NS	NS	NS	NS	NS

(NS- Non significant)

Conclusions

In a two years trial with Cv. Agrifound Dark Red, different levels of phosphorus and potassium did not affect the quality characters of onion. Higher levels of nitrogen, increased the yield significantly over all the treatment. Phosphorus and potassium did not show any significant alteration on yield and quality characters. The application of 150 kg N +80 kg P2O5 +100 Kg K2O/ ha was most appropriate combination of nutrients with respect to yield and quality of the rainy season onion crop propagated through seedling.

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