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Effect of different levels of nitrogen and phosphorus on yield and quality of onion seed (*Allium Cepa* L.) C.V. Agrifound light red

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Abstract
The present investigation entitled "Effect of different levels of nitrogen and phosphorus on growth, yield and quality of onion seed (*Allium cepa* L.) C.V. Agrifound Light Red" was carried out at Research area, College of Agriculture, Gwalior during 2020-21. The treatments consisted of factorial combinations of four levels of nitrogen (0, 40, 80 and 120 kg N ha^{-1}) and Phosphorus (0, 40, 80 and 120 kg N ha^{-1}) laid out in Factorial Randomized Block Design with three replications. Result of the study revealed that; N and P had shown a highly significant effect on yield and quality and yield parameters like test weight g, number of seeds per umbel, weight per umbel, seed yield per plot (g) maximum (395.48 g) recorded with N_4 120kg/ha + P_4 120kg/ha, seed yield per hectare (q) is maximum (9.89 q) found with N_4 120kg/ha + P_4 120kg/ha and on quality parameters like number of flowers per umbel, umbel diameter in cm, potassium content in leaf (%) is maximum (2.50%) found with N_4 120kg/ha + P_4 120kg/ha which were significantly superior over the rest of other treatments. This can be recommended for use by potential onion investors or farmers with high initial capital in the gird region of northern Madhya Pradesh

Keywords: Onion, nitrogen, quality, yield, umbel

Introduction
Onion (*Allium cepa* L., 2n = 16) is one of the most important bulb crop grown all over the world. It belongs to the family Alliaceae and believed to be originated from Central Asia comprising Iran, Afghanistan, Pakistan, Tadzhikistan and Uzbekistan. Onion (*Allium cepa* L.) is known as 'Queen of kitchen'. It is an indispensable item in every kitchen used as salad, culinary purpose for flavouring as spices in pickles, sauce and vegetable. In India, it is being cultivated as annual crop for bulb production and as biennial crop for seed production. It is a naturally packaged vegetable consisting of fleshy, concentric scales which are enclosed in paper-like wrapping leaves, connected at the base by a flattened stem disc.

As a nutritious vegetable, it contains carbohydrate (11.0g), protein (1.2g), calcium (180mg), phosphorus (50mg), iron (0.7mg), nicotinic acid (0.4mg), riboflavin (0.01mg) and vitamin C (11.0mg) in each 100g of edible portion (Bose *et al*., 2000) [6]. The pungency in onion is due to the presence of sulphur bearing compound in the volatile oil known as allyl-propyl disulphide ($C_6H_{12}S_2$). The colour of the outer skin of onion bulbs is due to the presence of "Quercetin". Catechol is a phenolic factor present in onion which has anti-fungal properties. It has got many medicinal values and is commonly used as diuretic and antidiabetic drugs. It is very useful against sun-strokes 'Loo' in summer. Onion (*Allium cepa* L.) is a biennial crop for the purpose of seed production. In one season bulbs are produced from seed and in the second season bulbs are replanted to produce seed. Quality seed is one of the basic and most important inputs for successful onion production. As onion seed is poor in keeping quality and loses its viability within a year, therefore it is essential to produce fresh seed every year and use the same for bulb production. In onions, seed yield and quality is influenced by many factors including cultivars, bulb weight, and spacing, date of planting, soil and climate and fertilizer application. Onion seed production may be increased by increasing the area with good variety and changing the existing management practices. But, the main constraint in increasing growing areas is the unavailability of sufficient quality seed during growing season.

Through improved seed production technology, both yield and quality can be improved, to fetch higher prices in the market.

Materials and Methods

Experimental site

The experiment was conducted at Research area, College of Agriculture, Gwalior during 2020-21 under agro-climatic and soil conditions of Northern Madhya Pradesh. the experimental area is situated at the of 26^0 13' North latitude and 76^0 14' East longitude with an altitude of 211.52 meters above Mean Sea Level in Gwalior district of the gird region of northern Madhya Pradesh.

Agronomical operations

Nursery raising

After selection of the site, the soil was ploughed to a good tilth. All weed plants, stones and other undesirable materials were collected and removed from the field. The beds were prepared and finally levelled. Beds were 2 x 2 meter in size and raised up to 15 cm from ground level. Prior to sowing, seeds were treated with mancozeb and sown in furrows opened 1 to 2 cm deep at 5 to 7 cm apart and just after dropping the seeds in the furrows they were covered well with fine soil and mulched with dry grass to facilitate early and uniform germination. Immediately, then light irrigation was given.

After care of seedlings

After sowing of seeds, the seedlings were regularly irrigated till the seedling was ready for transplanting. Weeding and plant protection measure was done as and when required.

Field preparation

The field was properly ploughed by disc harrow and then pulverized by disking and harrowing. There after field was levelled properly with heavy wooden planking by tractor and plots were prepared according to layout plan.

Application of manure and fertilizer

The calculated quantities of fertilizers were applied to the respective plot. The source of nutrients were nitrogen (DAP, Urea) phosphorus (DAP), potash (MOP). Half of nitrogen and whole of phosphorus and potash were applied as basal dose prior to transplanting of onion seedlings. While the rest of nitrogen was given in 2 equal split doses in transplanted onion seedling, first at 30 and second 45 days of transplanting.

Variety

The variety used in this experiment was Agrifound Light Red developed by NHRDF, Nasik which is having light red colour bulbs, 4-6 cm in diameter, moderately pungent, TSS-13% and good keeping quality.

Transplanting and gap filling

Fortyfive days old seedlings of uniform height were selected and transplanted in the field with the spacing of 45 cm row to row and 30 cm plant to plant. Gap filling was carried out 10 days after transplanting to maintain plants in each plot and light irrigation was given just after gap filling of seedlings.

Irrigation

Optimum soil moisture was maintained in the field by regular irrigation.

Weeding

It was done manually at 35 and 45 days after transplanting.

Plant protection measures

Spray of insecticide (Metasystox @ 1ml/l of water) and fungicide (Dithane M-45 @ 1g/l of water) with neem oil was done at interval of 15 days of transplanting for protection of crop from insect pest and diseases.

Harvesting

The crop was harvested on 1st March, 2021 when 75% tops start falling over but before the foliage is completely dry. The bulbs are harvested by hand pulling or with the help of hand hoe. The tops were removed one day after field curing leaving 2.5 cm top only with the bulb.

Observations recorded

Growth characters

Plant height (cm)

The plant height was measured from soil surface up to the tip of fully opened leaves with the help of measuring scale and average was worked out. Height of the five randomly selected and tagged plant was measured at 30, 60, and 90 days after transplanting and at harvesting.

Number of leaves per plant

The numbers of the leaves per plant were separately counted in five randomly selected and average was calculated in tagged plants at 30 and 60 days after transplanting

Days required to first anthesis

Days required from sowing to anthesis of the flower in 1% of the plants in a plot were counted to represent days taken to first flowering.

Number of seed stalks per plant

Seed stalks of five tagged plants were counted at harvest from each plot and average number of seed stalks/plant was calculated.

Height of umbel (cm)

The height of umbel was recorded with the help of centimetre scale and express value in cm.

Number of umbel per plot

Umbels of five tagged plants were counted at harvest from each plot and average numbers of umbels/plant was calculated and convert in number of umbels/plot.

Yield parameter

Thousand seed weight (Test weight g)

The seeds of all five randomly selected plants were mixed and randomly 1000 seeds were taken out from this lot and weighed.

Number of seeds per umbel

Twenty umbels were selected at random from the five tagged plants at harvest and total number of seeds was counted. Then the average of seeds/umbel was worked out.

Seed weight per umbel (g)

Five plants were selected randomly from each plot, tagged

permanently and used for weight of seed per umbel (g). Seeds of per umbel were separate and weighing with the help of weighing machine.

Seed yield per plot (g)
Seed harvested from all the plants in each plot including five observational plants were weighed at harvesting. The total yield per plot was calculated after harvesting.

Seed yield per hectare (q)
The produce harvested from net plot was threshed for recording seed yield. Seeds obtained were cleaned, dried and weighed in terms of kg/plot and then converted into q/ha.

Quality parameters
Number of flowers per umbel
Twenty umbels were selected at random from the five tagged plants at harvest and total number of flowers was counted. Then the average of flowers/umbel was worked out.

Umbel diameter
The diameter of umbel was measured with the help of varnier callipers and express value in mm.

Potassium content in leaf (%)
Estimation of total K in plants
Dilute the above plant digest 10 times by diluting 10 ml of it to 100 ml in a 100 ml volumetric flask and take reading of this diluted extract on flame photometer after adjustment it to 100 ml ppm K solution. The rest of the procedure is the same as described under k estimation in soils.

Results and Discussion

Yield parameters
Thousand seed weight (Test weight g)
The data regarding of different levels of nitrogen and phosphorus thousand seed weight (g) recorded in N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 1. The interaction effect between nitrogen and phosphorus levels exhibited no-significant influence on thousand seed weight (g). These results are also in accordance with the findings of Aliyu *et al.* (2007) [4], Kar *et al.* (2010) [12], El Abas *et al.* (2016) [8], Kamboj *et al.* (2017) [11] and Amare *et al.* (2020) [2].

Number of seeds per umbel
The data regarding of different levels of nitrogen and phosphorus number of seeds per umbel recorded in N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 1. The interaction effect between nitrogen and phosphorus levels exhibited no-significant influence on number of seeds per umbel. These results are also in accordance with the findings of Yadav *et al.* (2003a) [1], Joshi *et al.* (2005) [10], Khan *et al.* (2007) [13], Nasreen *et al.* (2007) [16], Farooqui *et al.* (2009) [9], Kar *et al.* (2010) [12] and El Abas *et al.* (2016) [8].

Seed weight per umbel (g)
The data regarding the seed weight per umbel influenced by different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 1. The combined effect of nitrogen and phosphorus levels showed no-significant influence on seed weight per umbel of onion. Similar findings have been earlier reported by Ali *et al.* (2008) [3], Kamboj *et al.* (2017) [11] and Amare *et al.* (2020) [2].

Seed yield per plot (g)
The results regarding the seed yield per plot (g) as influenced by different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 2. The combined effect of nitrogen and phosphorus levels was exhibited significant influence on seed yield per plot. The significantly maximum seed yield (395.48 g) recorded with N_4 120kg/ha + P_4 120kg/ha. However, treatment N_4P_4 was at par to treatment N_3P_4 and N_4P_3.

Seed yield per hectare (q)
The data regarding seed yield per hectare (q) as effect by different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 2. The combination effect of nitrogen and phosphorus levels showed significant influence on seed yield per hectare. The significantly maximum seed yield (9.89 q) found with N_4 120kg/ha + P_4 120kg/ha, whereas treatment N_4P_4 was at par to treatment N_3P_4 and N_4P_3.

Quality parameters
Number of flowers per umbel
The results on the number of flowers per umbel as impact by different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 2. The combined effect between nitrogen and phosphorus levels exhibited no-significant influence on number of flowers per umbel. Similar findings have been earlier reported by Yadav *et al.* (2003b) [18], Coolong *et al.* (2004) [7], Naruka *et al.* (2005) [15], Pachauri *et al.* (2005) [17], Kumar *et al.* (2006) [14] and Farooqui *et al.* (2009) [9].

Umbel diameter (cm)
The results on the umbel diameter (cm) as sway by different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 3. The interaction effect between nitrogen and phosphorus levels exhibited no-significant influence on umbel diameter. Similar results were reported by Banafar and Gupta (2005) [5].

Potassium content in leaf (%)
The result on the potassium content in leaf (%) as influenced by different different levels of nitrogen and phosphorus N_4 (120kg per hectare) and P_4 (120kg per hectare) is represented in the Table 3. The combination effect of nitrogen and sulphur levels significant influence the potassium content (%) in onion leaves. The significantly maximum potassium content (2.50%) found with N_4 120kg/ha + P_4 120kg/ha, whereas treatment N_4P_4 was at par to treatment N_3P_3, N_3P_4 and N_4P_3.

Table 1: Effect of different levels of nitrogen and phosphorus on test weight, number of seeds per umbel and seed weight per umbel (g)

Treatments Details		Test weight (g)	Number of seeds per umbel	Seed weight per umbel (g)
T_1	N_1× P_1	2.50	380.67	1.21
T_2	N_1× P_2	2.62	384	1.22
T_3	N_1× P_3	2.77	394.67	1.25
T_4	N_1× P_4	2.90	400	1.27
T_5	N_2× P_1	2.7	390	1.24
T_6	N_2× P_2	3.03	414	1.31
T_7	N_2× P_3	3.33	441.33	1.4
T_8	N_2× P_4	3.39	444.67	1.41
T_9	N_3× P_1	2.94	411.33	1.3
T_{10}	N_3× P_2	3.12	428	1.36
T_{11}	N_3× P_3	3.65	450	1.43
T_{12}	N_3× P_4	3.7	455.33	1.44
T_{13}	N_4× P_1	3.23	433.33	1.37
T_{14}	N_4× P_2	3.49	449.33	1.42
T_{15}	N_4× P_3	3.82	456	1.45
T_{16}	N_4× P_4	3.56	460	1.46
S.E(m)±		0.203	6.334	0.022
C.D. at 5%		NS	NS	NS

Treatment details

SN.	Nitrogen levels	Phosphorus levels
1.	N_1- 0 Kg/ha	P_1- 0 Kg/ha
2.	N_2- 40 Kg/ha	P_2- 40 Kg/ha
3.	N_3- 80 Kg/ha	P_3- 80 Kg/ha
4.	N_4- 120 Kg/ha	P_4- 120 Kg/ha

Table 2: Effect of different levels of nitrogen and phosphorus on seed yield per plot, Seed yield per hectare and number of flowers per umbel

Treatments Details		Seed yield per plot (g)	Seed yield per hectare (q)	Number of flowers per umbel
T_1	N_1× P_1	196.38	4.91	250
T_2	N_1× P_2	208.12	5.2	257.33
T_3	N_1× P_3	240.05	6.0	260
T_4	N_1× P_4	255.4	6.38	260
T_5	N_2× P_1	217.66	5.44	259.67
T_6	N_2× P_2	280.09	7.0	272.67
T_7	N_2× P_3	338.74	8.47	280
T_8	N_2× P_4	347.13	8.68	282.33
T_9	N_3× P_1	271.87	6.8	268.33
T_{10}	N_3× P_2	300.92	7.52	275.33
T_{11}	N_3× P_3	363.47	9.09	285.67
T_{12}	N_3× P_4	371.02	9.28	292.67
T_{13}	N_4× P_1	314.75	7.87	276.33
T_{14}	N_4× P_2	357.71	8.94	285.67
T_{15}	N_4× P_3	383.28	9.58	296.33
T_{16}	N_4× P_4	395.48	9.89	300
S.E(m)±		10.204	0.255	6.634
C.D. at 5%		29.468	0.737	NS

Table 3: Effect of different levels of nitrogen and phosphorus on Umbel diameter and Potassium content in leaf

Treatments Details		Umbel diameter (cm)	Potassium content in leaf (%)
T_1	N_1× P_1	4.02	1.5
T_2	N_1× P_2	4.24	1.53
T_3	N_1× P_3	4.41	1.68
T_4	N_1× P_4	4.48	1.75
T_5	N_2× P_1	4.39	1.6
T_6	N_2× P_2	4.73	1.88
T_7	N_2× P_3	5.21	2.02
T_8	N_2× P_4	5.36	2.11
T_9	N_3× P_1	4.57	1.84
T_{10}	N_3× P_2	4.9	1.95
T_{11}	N_3× P_3	5.61	2.36
T_{12}	N_3× P_4	5.75	2.41
T_{13}	N_4× P_1	5.03	1.98
T_{14}	N_4× P_2	5.44	2.16

T_{15}	N_4× P_3	5.86	2.44
T_{16}	N_4× P_4	5.91	2.5
S.E(m)±		0.181	0.053
C.D. at 5%		NS	0.153

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