Research Article

Response of Nitrogen and Phosphorous Levels on Growth and Yield of Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract

A field experiment was conducted of Bottle gourd variety Pusa Naveen during *summer (zaid)* 2015 at Instructional Farm Department of Horticulture, MJRP College of Agriculture & Research, Jaipur (Rajasthan). The experiment consisted of nine treatments (One control, two levels of nitrogen (60 and 110 kg ha^{-1}), two levels of phosphorus (50 and 70 kg ha^{-1}) and four combinations of both the levels of nitrogen and phosphorus) in randomized block design with three replications. Results of field experiment revealed that the maximum days required to opening female flower from sowing (43.26 days) and node number at which first female flower appears (6.92) was recorded under application of 110 kg N + 70 kg P_2O_5 ha^{-1} followed by application of 110 kg N + 50 kg P_2O_5 ha^{-1} (38.69 days) whereas, length of main vine and per cent fruit set were the maximum recorded under application of 110 kg N + 70 kg P_2O_5 ha^{-1}. Amongst fruit characters the maximum length of fruits (42.85 cm), girth of fruits (24.32 cm), fresh weight of fruit (1077.27 g) and number of fruits $plant^{-1}$ (13.44) were recorded under application of 110 kg N + 70 kg P_2O_5 ha^{-1}. The maximum number of days from anthesis to market harvesting was recorded under absolute control. Application of 110 kg N + 70 kg P_2O_5 ha^{-1} recorded significantly higher net returns (327756.52 Rs ha^{-1}) and B:C ratio (9.58) which was found.

Keywords: Bottle gourd, Nitrogen, Phosphorus, Growth, Yield

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Introduction

Cucurbits are mostly indigenous to India and they are widely grown throughout the country. Among various cucurbits, gourds are grown in maximum area *i.e.* 3.89 lakh hectares with 9.94 tonnes ha^{-1} productivity [1]. Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] known as calabash gourd or white flowered gourd, belongs to family cucurbitaceae, is one of the most important cucurbitaceous vegetable. It has become a popular crop because of prolific bearing habit and low cost of cultivation. In addition, tender fruits are used for making sweetmeats and dried fruits are used for making musical instruments. The vegetable requirement for the country has been estimated as 225 million tonnes by 2020. To achieve this target and to provide balanced diet, it is necessary to boost up the production of vegetables by increasing area, use of improved agro-technologies and by developing and using high yielding varieties/improved varieties. Bottle gourd is a rich source of carbohydrate content *viz.* crude fibre, sugars and different dietary fibre constituents like NDF, ADF, lignin, cellulose, hemicelluloses and mineral's like calcium, phosphorus and iron [2].

It curative properties for diuretic and high blood pressure patients and remove chronic constipation. It is also useful in curing the urinary disorders. It serves as an alkaliniger. In recent years a new technology has been developed for increasing the yield of vegetables, fruits, cereals etc. through the use of improved seeds. The improved seeds have been found to produce high yield and quality, if subjected to proper cultural practices. During the present investigation, an attempt has been made to find out the effect of various levels of nitrogen and phosphorus in an improved variety of bottle gourd. It is well known that an improved variety imparts better growth, high yield, uniform maturity and increase duration of harvest. Thus, keeping the above facts in mind there is a dire necessity to plan a field experiment for economic use of applied nutrients and maintenance of soil fertility at sustainable level of production.

Materials and Methods

The experiment was carried out at the Research Farm, Department of Horticulture, MJRP College of Agriculture & Research, Achrol, Jaipur, MJRP University, Jaipur (Rajasthan) during summer (Zaid) season of 2015. A field experiment was conducted of Bottle gourd variety Pusa Naveen during *summer (zaid)* 2015 at Instructional Farm

Department of Horticulture, MJRP College of Agriculture & Research, Jaipur (Rajasthan). The experiment consisted of nine treatments (One control, two levels of nitrogen (60 and 110 kg ha^{-1}), two levels of phosphorus (50 and 70 kg ha^{-1}) and four combinations of both the levels of nitrogen and phosphorus) in randomized block design with three replications.

Field preparation

The experimental field was ploughed twice with a tractor having disc plough, followed by cross harrowing. Each ploughing was followed by planking.

Fertilizer application

A basal dose of well rotten farm yard manure at the dose of 250 q ha^{-1} was incorporated in the soil before 20-25 days of sowing. The entire phosphorus and potash were given through single super phosphate and murate of potash at the time of sowing as basal dose whereas, the nitrogen in two split doses at sowing and 30 DAS as top dressing.

Sowing

The sowing was done in rows by keeping 2.0 m inter-row spacing and 2.0 m plant to plant spacing. At each hill, two seeds were sown at a depth of 2.5 cm. Before sowing, the seeds were soaked over- night in water to enhance germination. After germination one healthy and vigorous seedling was retained per hill.

Irrigation and intercultural operations

The plots were uniformly irrigated during whole season of crop growth at an interval of 4-6 days. Manual hoeing and weeding were done in all plots uniformly.

Plant protection measures

In order to protect the crop from the attack of insect and pests, cypermethrin 25% EC was sprayed at seedling stage and afterwards at 10 days interval till crop become 6 weeks old. Afterwards the crop was sprayed to protect the crop from aphids. No other pest and disease observed in the crop.

Harvesting

Only the tender and marketable healthy fruits were harvested and subsequent harvesting was done after every 7^{th} day till the crop was over. Plant growth parameters, fruit characters and yield contributing characters are observed.

Statistical analysis

The data collected were subjected to statistical analysis method of analysis of variance as described [3]. The critical difference for the treatment comparison was worked out, wherever the F test was found significant at 5% level of significance.

Results and Discussion

Effect of nitrogen and phosphorus levels on growth characters

Data (**Table 1**) reveals that the minimum days required to opening female flower from sowing was recorded under application of 110 kg N + 70 kg P_2O_5 ha^{-1} (36.36 days), followed by application of 110 kg N + 50 kg P_2O_5 ha^{-1} (38.69 days), whereas the maximum days (41.08) were noted under application of 60 kg N ha^{-1}, over absolute control (43.26 days). All the fertilizer treatments recorded significant decrease in node number at which first female flower appeared, over absolute control (6.92). Further, application of increasing doses of N + P fertilizers brought about significant decrease in node number at which first female flower appeared. Application of 110 kg N + 70 kg P_2O_5 ha^{-1} recorded significantly the lowest node number (4.95). The highest length of main vine (5.08 cm) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1} that was at par with the treatment $N_2 + P_1$ followed, by 110 kg N + 50 kg P_2O_5 ha^{-1} (4.97 cm), which was reduced by 29.33 per cent respectively, over absolute control (3.59 cm). Significantly highest per cent fruit set (54.20%) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}, which was higher by 43.15 and 29.43 per cent respectively, over absolute control (30.81%) and 60 kg N ha^{-1} (38.25).

Table 1 Effect of nitrogen and phosphorus levels on growth characters

Treatments (kg ha^{-1})	Days taken from sowing to the opening of first female flower	Node number at which first female flower appears	Length of main vine (cm)	Per cent fruit set
Control	43.26	6.92	3.59	30.81
N_1(60)	41.08	6.42	3.97	38.25
N_2(110)	40.68	5.97	4.03	39.24
P_1(50)	40.94	6.33	3.87	40.33
P_2 (70)	39.44	5.22	4.14	43.52
$N_1 + P_1$(60+50)	39.33	6.17	4.35	47.50
$N_1 + P_2$ (60+70)	39.00	5.45	4.54	49.68
$N_2 + P_1$ (110+50)	38.69	5.73	4.97	50.67
$N_2 + P_2$ (110+70)	36.36	4.95	5.08	54.20
SEm ±	1.20	0.14	0.16	1.69
CD (P = 0.05)	3.58	0.43	0.48	5.05
CV(%)	5.19	4.23	6.53	6.67

Table 2 Effect of nitrogen and phosphorus levels on fruit characters

Treatments (kg ha^{-1})	Length of fruits (cm)	Girth of fruits (cm)	Number of days from anthesis to market harvesting	Fresh weight of fruit (gm)
Control	21.71	15.01	14.58	710.58
N_1(60)	28.58	17.96	13.03	754.24
N_2(110)	32.31	20.00	12.82	815.14
P_1(50)	29.93	20.81	13.00	760.32
P_2 (70)	32.80	21.00	12.68	827.43
$N_1 + P_1$(60+50)	36.54	22.01	11.63	926.25
$N_1 + P_2$ (60+70)	38.60	22.34	11.39	955.71
$N_2 + P_1$ (110+50)	39.10	23.04	11.01	1041.06
$N_2 + P_2$ (110+70)	42.85	24.32	10.86	1077.27
SEm ±	1.30	0.79	0.49	32.60
CD (P = 0.05)	3.89	2.36	1.48	97.72
CV(%)	6.68	6.57	6.92	6.42

Table 3 Effect of nitrogen and phosphorus levels on yield contributing characters and Economics

Treatments (kg ha^{-1})	Number of fruits plant^{-1}	Yield plant^{-1} (kg)	Yield ha^{-1} (q)	Net returns (Rs ha^{-1})	B C ratio
Control	5.17	3.67	91.84	62218.47	2.10
N_1(60)	7.56	5.70	142.55	112146.16	3.69
N_2(110)	8.53	6.95	173.83	142772.41	4.60
P_1(50)	8.60	6.54	163.47	131594.80	4.13
P_2 (70)	10.28	8.51	212.65	179875.51	5.49
$N_1 + P_1$(60+50)	11.05	10.24	255.88	223221.36	6.84
$N_1 + P_2$ (60+70)	12.34	11.79	294.83	261281.34	7.79
$N_2 + P_1$ (110+50)	12.71	13.23	330.80	297490.62	8.93
$N_2 + P_2$ (110+70)	13.44	14.48	361.96	327756.52	9.58
SEm ±	0.45	0.38	10.84		
CD (P = 0.05)	1.35	1.14	32.50		
CV(%)	7.83	7.30	8.33		

Nitrogen is known to be the most important one among nutrients [4]. It is a constituent of the protoplasm, chlorophyll and the various hormones and growth regulators associated with the growth, production and translocation within the plant system. Nitrogen has been reported to have important role in increasing the vegetative growth and in the regulation on the use of P_2O_5 and K_2O [5]. Thus, all these functions have cumulatively acted upon to bring about all round improvement of the crop.

Phosphorus application resulted in significant effect on node number at which first female flower appeared and length of main vine. The study showed that the application of phosphorus increased number of lateral branches plant^{-1}. It appears that the preponderant effect of application of 110 kg N + 70 kg P_2O_5 ha^{-1} on various growth parameters of the bottle gourd to the level of sufficiency in the present investigation could be attributed to the overall beneficial effect on growth, yield attributes and yield of bottle gourd. These results also confirm the findings [6]. Application of increasing dose of fertilizer has also proved superior to the lower dose in respect of days taken from sowing to the opening of first female flower, node number at which first female flower appears, length of main vine and per cent fruit set [7].

Effect of nitrogen and phosphorus levels on fruit characters

The maximum length of fruits (42.85 cm) was obtained with application of 110 kg N + 70 P_2O_5 kg ha^{-1} that was at par with the treatment of $N_2 + P_1$, followed by 110 kg N + 50 kg P_2O_5 ha^{-1} (39.10 cm) respectively. The mean increase in the length of fruits was 49.33 and 33.30 per cent, respectively over absolute control (21.71 cm) and 60 kg N ha^{-1}.

The maximum girth of fruits (24.32 cm) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}, followed by 110 kg N + 50 kg P_2O_5 ha^{-1} (23.04 cm), which was higher by 38.28 per cent over absolute control (15.01 cm). However, it was found at par with the treatments of $N_1 + P_1$, $N_1 + P_2$ and $N_2 + P_1$.

Increasing doses of N + P fertilizers brought about significant reductions in days from anthesis to market harvesting. Significantly the lowest days from anthesis to market harvesting (10.86 days) were obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}.

Significantly the highest fresh weight of fruits (1077.27 g) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1} which was higher 34.04 per cent.

Marked increase in fruit characters of crop under application of 110 kg N + 70 kg P_2O_5 ha^{-1} appears to be account of vigorous growth in individual plant as reflected by increasing height, LAI and total biomass accumulation. Besides these, increased uptake of nutrients (N and P) clearly suggests better availability. This improvement seems to have facilitated plants to express their genetic capabilities for yield formation [8].

Nitrogen increased the synthesis of protoplasm and primarily in the manufacture of amino acid and increased auxin activity. It might have increased chlorophyll content of the leaves as well [15], which will enhance the rate of photosynthesis in leaf. The study showed that the application of phosphorus increases number of lateral branches plant^{-1} [9].

Effect of nitrogen and phosphorus levels on yield contributing characters and Economics

Application of increasing doses of N + P fertilizers brought about significant increase in number of fruits plant^{-1}. Significantly, the highest number of fruits plant^{-1} (13.44) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}.

The highest yield plant^{-1} (14.48 kg plant^{-1}) was obtained with the application of fertilizer 110 kg N + 70 kg P_2O_5 ha^{-1}, which were higher by 74.65 and 60.64 per cent, respectively over control (3.67 kg plant^{-1}) and 60 kg N ha^{-1} (5.70 kg plant^{-1}). Significantly, the highest fruit yield ha^{-1} (361.96 q ha^{-1}) was obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}, which was higher by 74.63 and 60.62 per cent, respectively over control (91.84 q ha^{-1}) and 60 kg N ha^{-1} (142.55 q ha^{-1}).

The highest monetary returns (327756.52 Rs ha^{-1}) were obtained with application of 110 kg N + 70 kg P_2O_5 ha^{-1}, which was higher by 81.02 per cent over control (62218.47 Rs ha^{-1}). Significantly, the highest B C ratio (9.58) was estimated with application of 110 kg N + 70 kg P_2O_5 ha^{-1}.

It has been well emphasized that N and P fertilization to the tune of 110 kg N + 70 kg P_2O_5 ha^{-1} play vital role in improving three major aspects of yield determination *i.e.* formation of vegetative structure for nutrient absorption, photosynthesis and source sink length through development of reproductive structure and production of assimilates to fill economically improved sink (source strength). Thus, cumulative influence of N and P application seems to have maintained balanced source sink through improving both the events of crop development (vegetative and generative), ultimately resulted in increased fruit yield (q ha^{-1}). The observed results are in close conformity with findings of [10] and [11].

Fruit yield plant^{-1} (14.48 kg) and fruit yield (361.96 q ha^{-1}) were also enhanced by application of 110 kg N + 70 kg P_2O_5 ha^{-1} and number of days from anthesis to market harvesting (14.58 days) was the maximum under absolute control. These results agree with the findings of [12].

The results showed that application of 110 kg N + 70 kg P_2O_5 ha^{-1} recorded significantly higher net returns (327756.52 Rs ha^{-1}) and B C ratio (9.58). This was probably due to higher benefits obtained with selection of appropriate nutrient responsive variety. These results also confirm the findings of [13], [14], [15] and [16].

Conclusion

On the basis of the results emanated from present investigation conducted during summer (zaid) 2015, it could be concluded that application of 110 kg N + 70 kg P_2O_5 ha^{-1} may be applied in improved bottle gourd to achieve higher fruit yield ha^{-1}, net returns and B : C ratio. However, these results are based on one year of experimentation; hence need validation through further experimentation before formulating recommendation.

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