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Economics and influence of fertility levels on growth and yield of Indian mustard (*Brassica juncea* Coss) under irrigated condition

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Abstract
A field experiment was conducted during the *Rabi* at the research farm, Janta Vedic College Baghpat, to evaluate the economics and influence of fertility levels on growth and yield of indian mustard (*brassica juncea* Coss) under irrigated condition. Among the different levels of treatments applied then the application of Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha increase growth parameters and yield than other treatments in comparison, there by resulting significant increase in growth and yield attributes *viz.* plant height (178.34 and 177.84 cm), no. of branches/plant (7.94 and 7.92), dry matter accumulation, no. of siliquae/plant and seeds/ siliquae, seed (15.94 to16.58 q/ha) and straw yield of Indian mustard. Application of Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha increased the yield of Indian mustard significantly over other treatments, besides realised at B: C. ratio of 2.34 to 2.36. The highest gross returns Rs 25450 and 25555 per hectare and highest net returns of Rs 14551 and Rs 14731 per hectare was recorded with Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha

Keywords: plant growth, yield and economics

Introduction
Indian mustard is the third important oilseed crop in the world after soybean and palm oil. This group of crops has diversified domestic and industrial uses. It is an important source of edible oil, condiment and vegetable in the Indian diets. The seed oil in mustard ranges from 40 to 42%. Its oil is widely used for edible purpose and is highly used for vegetables and fish frying because of particular taste and pungency due to "Allyliso thiocynate" and related compounds in it. A portion of oil is also used for various non-edible uses such as lubricants and as illuminating oil. Rape and mustard oil is also used in preparation of rubber additive, chrome and tanning in the manufacture of varnishes, plasticizers, medicinal uses, massage and in the manufacture of synthetic. After the recovery of oil from rape and mustard seed, the residual meal is the rape or mustard cake. These crops have to play an important role in Indian oil economy considering their suitability to grow under diverse agro-ecological situations. In India, oilseeds are the second largest agricultural commodity after cereals. Among oilseeds, rapeseed-mustard is the second important edible oilseed crop in India after groundnut sharing about 27.8% in the India's oilseed economy, belongs to the family Cruciferae (Brassicaceae). The area, production and productivity of rapeseed-mustard in India is 6.70 million ha, 7.96 million tones and 1188 kg ha-1, respectively during the 2015-16 (Anonymous, 2016). Indian mustard accounts for about 75–80 % of the total area under this crop in the country.
Thus it offers considerable scope through improved agro-technology. In view of high pressure on land due to increase in extending this crop to the new area except with irrigation provisions in arid zones but it is very difficult to achieve. In recent years, the evolution of short duration and high yielding genotypes of mustard (*Brassica juncea*) which could be successfully fitted in various intensive cropping system of area.
Application of inadequate and unbalanced quantities of nutrients to the crop also resulted in lower yield levels. Amongst all the Brassica species, mustard has been reported to highest feeder (Ansari, H. R. 1996) [1]. Nitrogen and Phosphorus are the essential components of protoplasm and chlorophyll materials and there quantities are essential to maximum photosynthetic activities for the synthesis of carbohydrates in the plants and their conversion into plant lipids. Thus becomes added importance during the present oilseed crises in India, thus growth and yield behavior of newly evolved cultivar Varuna of India mustard need to be

Studied exploiting maximum yield potential under varying levels of nitrogen and phosphorus in this irrigated and intensive cropping systems area under subtropical agro-eco systems of western U.P.

Materials and Methods

A field experiment was conducted at the research farm, Janta Vedic College Baghpat during the *Rabi*. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction, low in organic carbon (0.48%) and available nitrogen (241 kg/ha) and was medium in available phosphorus (13.6 kg/ha) and potassium (262.4 kg/ha). Indian Mustard variety Varuna was sown in 30 cm inter row and 10 cm intra row spacing on 25th of October during both the years of experimentation using 4-6 kg seed ha^{-1}. The experiment of nine treatments comprising of unfertilizer and low fertilizer under different levels of treatments i.e. Nitrogen 0, 50, 100 and Phosphorus 0, 40, 80 kg/ha were arranged in a randomized block design with four replications.

Results and discussion

Plant growth

Plant height is not a yield component especially but it indicates the influence of various nutrients on plant metabolism. It was found the application of nitrogen level (100 kg/ha) increases plant height. The different levels of treatments measures exhibited significant variation in respect of growth parameters. Nitrogen @ 100 kg/ha (Table 1) produced taller plant closely followed by Phosphorus @ 80 kg/ha as compared to unfertilizer treatment. The superiority of Nitrogen @ 100 kg/ha and Phosphorus @ 80 kg/ha at harvest stage in term of shoot height might have accrued to increase. Similarly maximum number of branches per plant in Indian mustard crop was recorded with Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha (7.92 to 7.94). Dry matter production is the resultants of growth characters viz. plant height, number of branches/plant and leaf area index, the highest dry matter accumulation, no. of siliqaue/plant, wt. of siliqaue/plant, no. of seeds/siliqaue, seed wt. /plant, 1000 seed weight and seed yield of Indian mustard crop with Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha (Table 2). This indicates that 100% N requirement of crop plants was substituted. The increase in growth parameter of Indian mustard was attributed to the beneficial effect. The results are in accordance with the findings of Chauhan *et al.* 1995 [2] and Kumar *et al.* 1997 [5].

Table 1: Influence of fertility levels on growth and yield attributes of Indian mustard at harvest stages *{Pooled Data of Two Years}.*

Treatments	Plant height	No. of branches/ plant	No. of siliquae/ plant	Wt. of siliquae/ plant (g)	Dry matter accumulation	No. of seeds/ siliquae	Seed wt./ Plant (g)
Nitrogen 0 kg/ha	158.92	7.12	335.82	49.81	82.45	14.28	23.29
Nitrogen 50 kg/ha	173.26	7.56	392.77	59.22	92.87	14.82	29.62
Nitrogen 100 kg/ha	178.34	7.94	430.42	65.43	105.82	14.98	32.34
Phosphorus 0 kg/ha	163.24	7.08	231.61	49.18	80.74	14.26	23.17
Phosphorus 40 kg/ha	174.44	7.62	436.26	58.76	90.72	14.81	28.78
Phosphorus 80 kg/ha	177.84	7.92	491.14	66.52	109.68	15.01	33.30
S em ±	0.55	0.14	2.30	2.05	2.37	0.21	0.91
CD (P=0.05)	1.58	0.42	6.65	5.93	6.86	N.S	2.63

Table 2: Influence of fertility level on yield and yield attributes of Indian mustard at harvest stages *{Pooled Data of Two Years}.*

Treatments	1000 seed wt. (g)	Seed yield (q/ha)	Straw yield (q/ha)	Stick yield (q/ha)	Biomass (q/ha)
Nitrogen 0 kg/ha	4.59	11.95	12.66	30.69	55.30
Nitrogen 50 kg/ha	4.64	14.76	13.84	37.26	65.86
Nitrogen 100 kg/ha	4.76	15.94	15.23	38.74	69.91
Phosphorus 0 kg/ha	4.56	11.68	12.58	30.43	54.69
Phosphorus 40 kg/ha	4.69	14.39	13.67	36.48	64.54
Phosphorus 80 kg/ha	4.74	16.58	15.48	39.78	71.84
S em ±	0.046	0.41	0.37	0.46	1.38
CD (P=0.05)	N.S	1.18	1.08	1.34	3.99

Yield

Maximum seeds yield was recorded with Nitrogen @ 100 kg/ha (15.94 q/ha) and Phosphorus @ 80 kg/ha (16.58 q/ha) had significant as comparable to other treatments (Table 2 and Fig. 1). The increase in yield in these treatments might be due to the positive effect on yield attributing factors such as no. of branches/plant, dry matter accumulation, no. of siliqaue/plant, wt. of siliqaue/plant, no. of seeds/siliqaue, seed wt. /plant and 1000 seed weight of Indian mustard. Similarly the different treatments produced significant higher straw and stick with Nitrogen @ 100 kg/ha (15.23 and 38.74 q/ha) or Phosphorus @ 80 kg/ha (15.48 and 39.78 q/ha) as compared to other treatments by Singh *et al.* 1995 [3, 10].

Economics

The variables like seed, fertilizer and weed management were considered as cash inputs for the demonstrations as well farmers practice. Economic returns as a function of seed yield and sale price varied during different years. More returns were obtained due to higher sale price and higher seed yield of Indian mustard respectively. The maximum gross returns Rs 25450 and 25555 per hectare and highest net returns of Rs 14551 and Rs 14731 per hectare was recorded with Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha and the highest B. C. ratio of 2.34 to 2.36 was recorded with Nitrogen @ 100 kg/ha or Phosphorus @ 80 kg/ha (Fig. 2). This show that Indian mustard is more responsive towards the inputs use and under good management and it can give even higher returns (Table 3).

Table 3: Relative economics of fertility levels in Indian mustard.

Treatments	*{Pooled Data of Two Years}*			
	Cost of cultivation	**Gross return (Rs/ha)**	**Net Return (Rs/ha)**	**B: C ratio**
Nitrogen 0 kg/ha	9312	13196	3884	1.42
Nitrogen 50 kg/ha	11499	20486	8987	1.78
Nitrogen 100 kg/ha	10899	25450	14551	2.34
Phosphorus 0 kg/ha	11433	16667	5234	1.46
Phosphorus 40 kg/ha	11471	20242	8771	1.76
Phosphorus 80 kg/ha	10824	25555	14731	2.36

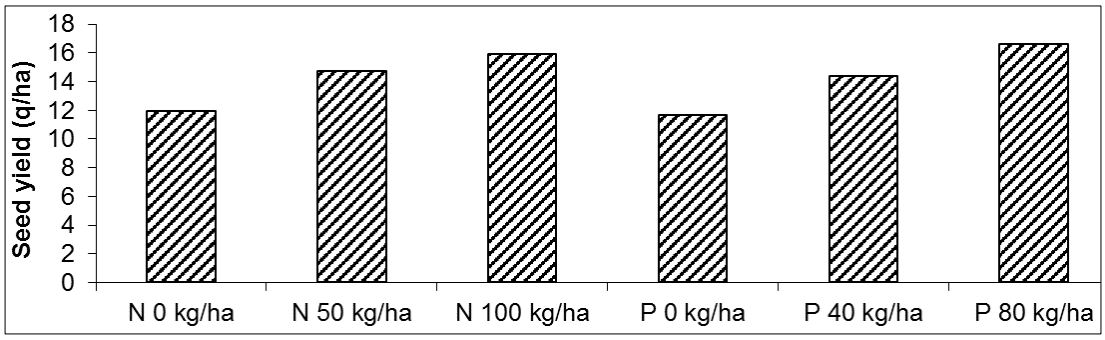

Fig 1: Influence of fertilizer on growth and yield of Indian mustard at harvest stages

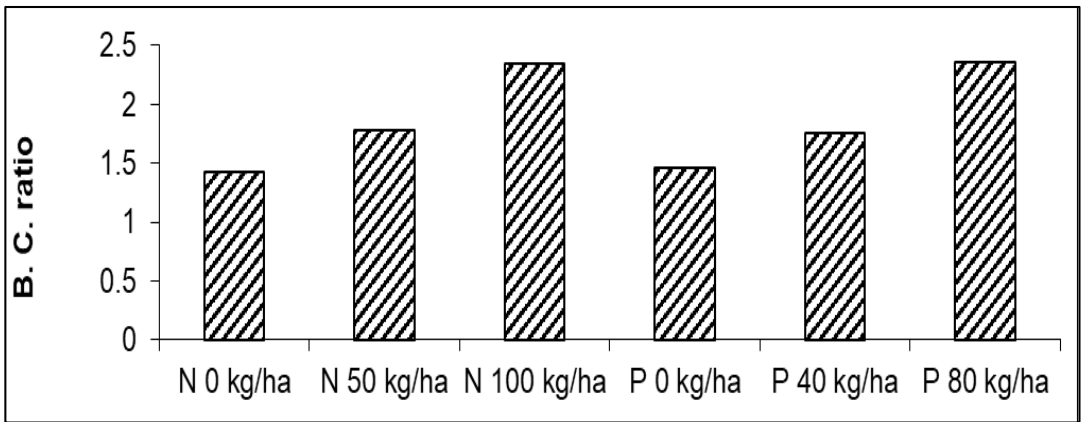

Fig 2: Relative B. C. ratio of fertility levels in Indian mustard

Conclusion

Considering the results obtained from the study it can be concluded that the application Nitrogen @ 100 kg/ha and Phosphorus @ 80 kg/ha recording higher productivity and profitability of Indian mustard

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