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Effect of integrated nutrient management on growth and yield in mustard [*Brassica juncea* (L.) Czern & Cosson]

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Abstract
Continuous and sole application of artificial or inorganic fertilizer induces the soil sickness and disturbs the soil environment, to result in low productivity and unsustainability. Therefore, an experiment was conducted during *Rabi* season 2015-16 at Students' Instructional Farm (SIF), C.S.A.U.A&T Kanpur. Twelve treatments were tested in three replicated Randomized Block Design. Result found that significantly better growth attributes (plant height and dry weight), yield attributes (number of siliqua plant^{-1} and length of siliqua) and yield (24.30 q/ha) was obtained with combined application of RDN 50% + 25% FYM + 25% vermicompost + 30 kg S + azotobacter over rest of the treatments. The minimum grain yield (20.15 q/ha) was received in treatment 100% RDN. Thus, mustard fertilized with RDN 50% + 25% FYM+25% vermicompost+30 kg S +azotobacter is to be recommended for mustard production.

Keywords: INM, Growth, Yield attributes and yield

Introduction
Oilseeds, the second largest agricultural commodity after cereals in India, play a significant role in India's agrarian economy, sharing 14% of the gross cropped area and accounting for nearly 1.5% of the gross national production and 8% of the value of all agricultural products. Indian mustard (*Brassica juncea* L.) belongs to the family Cruciferae is one of the most important winter oilseed crop. The Main growing state are Rajasthan, Gujarat, M.P., Uttarakhand, Uttar Pradesh, Bihar, West Bengal and Assam. India occupies third position in rapeseed-mustard production in the world after China and Canada (Anonymous, 2017) [1].

Integrated Nutrient Management(INM) involves efficient and judicious use of all the major components of plant nutrient sources viz. chemical fertilizer in conjunction with animal manures, compost, green manures, legumes in cropping system, biofertilizers, crop residues, or recyclable waste and other locally available nutrient sources for sustaining soil fertility, health and productivity. The integrated supply and use of plant nutrients from chemical fertilizer and organic manures has been found to produce higher crop yield than when each is applied alone. This increase in crop productivity results from their combined effect, the synergistic effect, that help improve chemical, physical and biological properties of soil and consequently the soil organic matter and nutrient status, to large extent balance nutrient supply to crops of cropping systems and with no or minimal deleterious effect on environment if any. The basic objective of the integrated nutrient management is to make as far as possible, balanced nutrient supply to crop that maintains and also improves the soil fertility health for sustained high productivity on a long term basis. As plant nutrient sources differ markedly in their nutrient contents, release efficiency or fixation, positional availability, crop specificity, farmer's acceptability, etc., their appropriate combinations to a production system for optimum and balance nutrient supply depends on the land use, ecological, sociological and economic conditions. Moreover, significant response of oilseed to the tune of 30-40% was recorded due to the use of secondary major nutrients and micronutrients and with significant residual effect in cropping system (Hegde and Babu, 2016) [4]. Therefore, existing study was deliberate to assess the effect of integrated nutrient management on growth and yield in mustard.

Materials and Methods

Experimental details and site description

The present investigation was carried out at students Instruction Farm, Chandra Shekhar Azad university of Agriculture & Technology, Kanpur (U.P.). The present experiment was carried out during *Rabi* 2015-2016 in field at Students' Instructional Farm (SIF).The field was well leveled and irrigated by tubewell the farm is situated in west northern part of Kanpur city under subtropical zone in 5th agro-climatic zone(central plain zone).Farm is falling in alluvial belt of gangetic plain of U.P. between $25^0 56'$N to $28^0 58'$N latitude and $79^0 31'$ to 80^0 E longitudes and at an elevation of 125.9 meter from mean sea level. The average weekly maximum and minimum temperatures during the crop growth period ranged from 33.90^0C and 17.3 ^{0}C and 16.9 ^{0}C to 9.2 ^{0}C respectively. The relative humidity ranged between 42.1 to 85.5%, wind speed between 1.9 to 6.00 km/hr. Total evaporation ranged from 1.3 to 3.5 mm. The total rainfall received during the crop period was 23.3 mm. The soil of experimental field was slightly alkaline in reaction with 7.9 pH, low in organic carbon (0.32%) and low in available nitrogen (180.4 kg ha^{-1}), phosphorus (18.4 kg ha^{-1}), medium in potassium (290 kg/ha), available sulphur 7.3 (ppm) and available Zinc 0.59 (ppm). All the soil properties were analyzed as per the standard procedures adopted by Page (1982) [6]. The experiment consist of 12 treatments combinations which were laid out in Randomized Block Design with three replications.

Data collection

The various observations on growth attributes (plant height and dry weight) and yield attributes (Number of siliqua plant^{-1} and Length of siliqua) were recorded as per standard procedure at 90 DAS and at harvest. Moreover, yields viz., grain, straw and harvest index of mustard (q/ha) was worked out in different plot of the experimental field.

Statistical analysis

The data on various parameters were exposed to statistically analyze as drew by Gomez and Gomez (1984) [3]. The treatment variances were tested by using "F" test and critical differences (at 5 per cent probability).

Results and Discussion

Plant population

It is evident from the Table 1 that the various treatments was not influenced in the plant stand/m^2 after thining 30 DAS and at harvesting but the treatment RDN 50% + 25% FYM + 25% vermicompost +30 kg S + azotobacter (T_{11}) was observed statistically superior than rest of the treatments respectively, Seed in the presence of moisture begins to germinate, starch of grains begins to break down and is converted into sugar to provide quick energy during conversion from starch to sugar, phosphorus in the form of insoluble organic compound in the seed converted into water soluble forms. These findings are corroborates with those of Premi *et al.* (2005) [7] and Singh and Singh and Pal (2011) [9].

Pal (2011).

Growth attributes

The highest plant height and dry weight per plant (Table 1) at 90 DAS and harvesting were recorded in the RDN 50% + 25% FYM + 25% vermicompost + 30kg S + Azotobacter was observed statistically with more over RDN 50% + 25% FYM + 25%vermicompost + 30kg S, RDN 50% + 25% VC + 25% FYM, RDN 75% + 12.5%VC + 12.5% FYM + 30kg S, RDN 75% + 12.5%VC + 12.5% FYM + 30kg S+ azotobacter, RDN 75% + 12.5%VC + 12.5% FYM, RDN 75% + 25%VC, RDN 75% + 25%FYM, RDN 50% + 50% VC, RDN 50% + 50% FYM, RDN 100% and RDN 100%+30 kg S. The reason behind higher plant height and more dry matter in integrated nutrient supply may be the proper establishment of crop plants, increased height and larger vegetative growth. These results are in close conformity of
Premi *et al.* (2005) [7] and Singh and Pal (2011) [9].

Table 1: Effect of integrated nutrient management on different parameters of mustard

Treatment	Plant population (DAS)		Plant height (cm)		Dry weight (gm)	
	30 (DAS)	At harvesting	90 (DAS)	At harvesting	90 (DAS)	At harvesting
T_1-100% RDN	24.93	24.88	137.33	145.25	133.10	140.21
T_2-75% RDN+ 25% FYM	25.98	25.15	140.24	150.21	138.24	149.77
T_3-75%RDN +25% N VC	25.04	24.94	142.44	150.44	142.00	155.24
T_4-75% RDN + 12.5% FYM + 12.5% VC	25.88	25.68	143.14	151.43	143.24	156.74
T_5-75% RDN + 12.5% FYM + 12.5% VC + 30 kg S	26.73	26.68	145.70	153.28	149.24	161.49
T_6- 75% RDN + 12.5% FYM + 12.5% VC + 30 kg S + Azotobactor	26.89	26.80	146.20	154.21	150.24	162.10
T_7-50% RDN + 50% N FYM	26.01	25.88	144.20	152.84	146.24	159.24
T_8-50% RDN + 50% VC	26.07	26.01	145.00	153.21	148.41	160.01
T_9-50% RDN +25% FYM + 25% VC	27.03	26.94	148.24	155.21	153.24	163.00
T_{10}-50% RDN + 25% FYM + 25% VC + 30 kg S	27.67	27.61	149.44	155.24	154.11	163.29
T_{11}- 50% RDN + 25% FYM + 25% VC + 30 kg S + Azotobacter	27.87	27.81	150.66	156.88	154.89	164.00
T_{12}-100% RDN + 30 kg S	26.92	25.78	142.94	151.66	144.27	158.84
SE(d)±	2.03	2.03	2.096	2.048	2.0842	2.8382
CD at 5%	NS	NS	4.348	4.248	4.323	5.887

Yield attributes

Data presented in Table 2 revealed that the maximum produce of siliqua per plant and siliqua length (cm) were recorded in RDN 50% + 25% FYM + 25% vermicompost + 30kg S + Azotobacter followed by the RDN 50% + 25% FYM + 25% vermicompost + 30kg, RDN 50% + 25% FYM + 25% vermicompost, RDN 75% + 12.5%VC + 12.5% FYM + 30 kg S + azotobacter, RDN 75% + 12.5%VC + 12.5% FYM + 30 kg S, RDN 50% + 50% Vermicompost, RDN 50% + 50% FYM ,and RDN 100% + 30 kg S, RDN 75% + 12.5% FYM + 12.5% vermicompost , RDN 75% + 25% VC , RDN 75% + 25% FYM and in RDN 100% minimum siliqua . in respect to siliqua length and seeds per siliqua. Since the number of siliquae on primary and secondary branches per plant is also a result of total number of siliquae per plant. The use of FYM and vermicompost consequently had more siliqua length, seed

per siliqua has also been reported by Singh and Singh (2006) [8] and Kashved *et al.* (2010) [5].

Yield

Data presented in Table 2 discovered that maximum produce of grain yield and stover yield q/ha of mustard were recorded in RDN 50% + 25% FYM + 25% vermicompost + 30kg S + azotobacter, followed by rest, RDN 75% + 12.5%VC + 12.5% FYM + 30kg S, RDN 50% + 50% Vermicompost, RDN 50% + 50% FYM ,and RDN 100% + 30 kg S , RDN 75% + 12.5% FYM + 12.5% vermicompost , RDN 75% + 25% VC , RDN 75% + 25% FYM and in RDN 100% in respect to grain yield and stover yield while the maximum harvest index was received in in RDN 50% + 25% FYM + 25% vermicompost, RDN 75% + 12.5%VC +12.5% FYM + 30kg S+ azotobacter RDF followed by other rest treatments. The most probable reason for this phenomenon may be longer plant and increased dry matter, more vegetative growth under organic and inorganic nutrient supply. This might had resulted to increase stover yield and grain yield production by Tripathi *et al.* (2010) [10] and Premi *et al.* (2005) [7] reported similar result as yields.

Table 2: Effect of integrated nutrient management on different parameters of mustard

Treatment	Number of siliqua plant^{-1}	Length of siliqua (cm)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
T_1-100% RDN	223.29	5.34	20.15	70.67	21.70
T_2-75% RDN+ 25% FYM	244.28	5.64	21.20	76.10	21.56
T_3-75%RDN +25% N VC	247.43	5.75	21.50	77.20	21.69
T_4-75% RDN + 12.5% FYM + 12.5% VC	250.49	5.87	21.80	78.15	21.60
T_5-75% RDN + 12.5% FYM + 12.5% VC + 30 kg S	280.47	6.41	22.10	81.10	21.22
T_6- 75% RDN + 12.5% FYM + 12.5% VC + 30 kg S + Azotobactor	285.40	7.19	22.75	81.40	21.63
T_7-50% RDN + 50% N FYM	275.27	5.99	21.90	80.30	21.24
T_8-50% RDN + 50% VC	279.87	6.02	22.15	80.70	21.32
T_9-50% RDN +25% FYM + 25% VC	289.49	7.82	23.10	82.60	21.64
T_{10}-50% RDN + 25% FYM + 25% VC + 30 kg S	290.00	7.91	23.60	84.15	21.71
T_{11}- 50% RDN + 25% FYM + 25% VC + 30 kg S + Azotobacter	295.00	8.01	24.30	86.50	21.73
T_{12}-100% RDN + 30 kg S	273.44	5.94	21.75	79.10	21.40
SE(d)±	7.122	0.247	0.9388	1.2513	0.268
CD at 5%	14.77	0.514	1.947	4.269	NS

Conclusion

Result reveal that significantly better growth attributes, yield and grain yield (24.30 q/ha) was obtained with combined application of RDN 50% + 25% FYM+25% vermicompost+30 kg S +azotobacter over rest of the treatments. Thus, mustard fertilized with RDN 50% + 25% FYM+25% vermicompost+30 kg S +azotobacter is to be recommended for mustard production.

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