The Pharma Innovation Journal 2022; 11(7): 1688-1692

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 1688-1692

www.thepharmajournal.com
Received: 02-04-2022
Accepted: 17-06-2022

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To study the effect of different sowing date and sea weed extract on production and productivity of Indian mustard (*Brassica juncea* L.)

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Abstract
This experiment was carried out during *Rabi* season of 2021-22 at Agricultural Research Farm of faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur Nagar (U.P). The present experiment was laid out in split plot design, the experiment consists of three dates of sowing in main plot *viz;*5 October date (D_1), 15 October date (D_2), 30 November (D_3) and 4 treatments *viz*; where granule sea weed extract (T_1) Control, (T_2)15 kg ha^{-1} granule sea weed extract, (T_3)20 kg ha^{-1} granule sea weed extract (5 Tonns /ha), (T_4) 25 kg ha^{-1} granule sea weed extract in sub plot with three replications in Indian mustard. The results of this experiment result indicate the growth parameter *viz*; plant height, number of primary and secondary and yield attributing character and yield Indian mustard *viz*; number of siliqua/ plants, siliqua length, number of seed/siliquae, weight of siliqua, weight of seed / plant and test weight and seed and straw yield of was recorded maximum from date of sowing at (D_2) 15 October which were statistically at par with date of sowing at 5 October. The least number of primary branches was estimated from 30 November date of sowing of mustard crop. Similarly, in case of soil application of sea weed extract on growth and yield attributing character and yield of mustard crop with was documented from soil application of granule sea weed extract (T_4) 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum seed yield of mustard crop was recorded from control plot. However, the least Number of seed per plant was estimated from control plot. The maximum net return and B:C ratio of mustard crop was recorded from date of sowing at 15 October (Rs. 60,836 ha^{-1}) followed by with date of sowing at 5 October. (Rs. 78,884 ha^{-1}). The minimum net return of mustard crop was recorded from date of sowing at 30 November. (Rs. 70,102 ha^{-1})Although, soil application of sea weed extract was significantly influencing the net return of mustard crop. The maximum net return of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} (Rs. 76,965 ha^{-1}) followed by soil application of granule sea weed extract 20 kg ha^{-1}. (Rs. 71,671 ha^{-1}) However, the minimum net return of mustard crop was recorded from control plot. (Rs. 64,162 ha^{-1}).

Keywords: Date of sowing, seaweed extract, growth, quality

Introduction
Globally India is one of the chief oilseeds producing country. However, the oilseeds are second largest agricultural commodity after cereals in term consumption in India. It has a significant contribution in term GDP India's agricultural economy, accounting approximately 14% of the total gross cropped area and comprise almost 1.5% of the all-national production and 8% in term of Monterey value in all agricultural products. Total oilseeds covered area about in India is 26.20 Mha and as well as production nearly 32.10 million tons in 2016-17 and its productivity in the country is 1225 kg ha^{-1} (Annual report 2017-18 DAC&FW).
A wide range of oilseed crops grown in India *viz*. groundnut, rapeseed and mustard, soybean, sesame, sunflower, safflower and Niger (edible) and linseed and castor (non-edible) are sown. In India, the demand of vegetable oil is continuously increasing due to quantum jump in population, standard of living and fast industrialization and synthesis for bio-fuels from oil seed crop. The gap in supply and demand is being convene through huge imports costing more than >Rs.73,048 corers (Annual reports 2017-18 DAC&FW).
Mustard Seeds are acknowledged by different names in different e.g., sarson, rai or raya, toria or lahi, while sarson and toria (lahi) are generally called as rapeseed, rai or laha is termed as mustard or Indian mustard. The oil obtained from the different type of oil seed be evidence for slight variation in percentage of oil content. The oil percentage varies from 36-48%. The seed and oil is used as condiment in the preparation of pickles and flavouring curries, vegetables

and also it use as food preservative agent. The oil is used for human consumption all over northern India region specially in cooking of food and for frying purposes. It is utilized in soap making industries, lubrication and bio-fuels. Rapeseed oil is hand in the manufacture of grease. The oil seed cake is used as a feed for cattle and manuring. Its green stems and leaves are a finer source of green fodder for livestock and the leaves and stem of young plants are used as green vegetables as they supply enough sulphur and minerals nutrition in the food diet. In tanning industry, Mustard oil is used for softening agent to leather. Oil is rich sources of protein, sugar, minerals nutrition and many vitamins.

Seaweed has long been utilized directly as a soil conditioner and as fertilizer in various coastal areas in all over the world and seaweed extracts have also been widely marketed as additives to plant fertilizers which have benefits have been widely reported Utilization of seaweed as fertilizer seem a cheapest alternative solution to environmental problems because it is non-harmful for soil and plant microbes also. The uses of seaweed-based bio-products gaining momentum in crop production systems owing to their unique bioactive components and simulative effects on plant growth. They have phyto-stimulatory tendency that increased plant growth and yield parameters in various important crop plants. This possesses phyto-elicitor activity as their components inducing defence responses in plants that contribute in mechanism of resistance to several pests, diseases, and a biotic-stresses counting drought, salinity, and cold priming the plant defences against future attacks. Seaweed extracts contain a plethora of substances which are mostly organic, but trace levels of inorganic nutrient elements are also available. Whole seaweed extracts have been consistently proven to be very efficient useful, which places of interest the role of multiple components and their complex combined effects on plant growth processes. Since seaweed extracts are mainly organic, they are preferably suited for organic farming and environmentally sensitive crop production. The review further analyses the potential value of seaweed extracts in integrated crop management systems towards sustainable crop production.

Materials and Method

Geographically, Kanpur is situated in sub tropical region at an altitude of 125.9 meter from the mean sea level and latitude ranging of 25^0 56’ to 28° 58’ North and longitude 79° 31' to 80° 34' East. The climate of locality is semi arid with moderate rainfall and cold winters. The mean annual rainfall is 850 mm extending generally from the mid June to mid October. The temperature rises maximum during May - June (45 – 48 °C) and come down to 4 -5 ^0C during December - January. Occasional showers are also received during winter and summer**.**

The experiment was laid out in SPD with three replication, the factors are date of sowing, 5 October date (D_1), 15 October date (D_2), 30 November (D_3) and 4 treatments *viz*; where granule sea weed extract (T_1) Control, (T_2)15 kg ha^{-1} granule sea weed extract, (T_3)20 kg ha^{-1} granule sea weed extract (5 Tonns /ha), (T_4) 25 kg ha^{-1} granule sea weed extract in sub plot with three replications.

Result and Discussion

Initial plant population per running meter row length of mustard crop does not show significant results due to date of sowing and soil application of sea weed extract of mustard crop. The interaction effect of date of sowing and soil application of sea weed extract of mustard crop does not show significant results on initial plant population.

The maximum plant height was recorded from date of sowing at 5 October which were statistically at par with date of sowing at 15 October. However, the plant height of mustard crop at 45 DAS does not show significant results due soil application of sea weed extract. The maximum plant height at 60, 90 DAS and harvest stage was documented from date of sowing at 5 October which were statistically highest date of sowing at 15 October. However, the minimum plant height at 60, 90 DAS and harvest stage was recorded from date of sowing at 30 November. The maximum plant height at 60, 90 DAS and harvest stage was documented from soil application of granule sea weed extract 25 kg ha^{-1}which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum plant height at 60, 90 DAS and harvest stage was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on plant height.

The maximum number of primary branches of mustard crop at 60 DAS was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum number of primary branches of mustard crop at 60 DAS was recorded from date of sowing at 30 November. The maximum number of primary branches of mustard crop at 60 DAS was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum number of primary branches of mustard crop at 60 DAS was recorded from control plot.

The maximum number of secondary branches of mustard crop at 90 DAS was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum number of secondary branches of mustard crop at 90 DAS was recorded from date of sowing at 30 November. The maximum number of secondary branches of mustard crop at 90 DAS was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum number of secondary branches of mustard crop at 90 DAS was recorded from control plot.

Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on number of primary branches of mustard crop at 60 and 90 DAS.

The maximum number of siliquae/ plants of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum number of siliquae/ plants of mustard crop was recorded from date of sowing at 30 November. The maximum number of siliquae/ plants of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum number of siliquae/ plants of mustard crop was recorded from control plot. The interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on number of siliquae/ plants of

mustard crop.

The maximum siliqua length of mustard crop was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum siliqua length of mustard crop was recorded from date of sowing at 30 November. The maximum siliqua length of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum siliqua length of mustard crop was recorded from control plot.

Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on siliqua length of mustard crop.

The maximum number of seed/siliquae of mustard crop was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum number of seed/siliquae of mustard crop was recorded from date of sowing at 30 November. The maximum number of seed/siliquae of mustard crop was documented from soil application of granule sea weed extract 25 kg ha-1 which were statistically higher than soil application of granule sea weed extract 20 kg ha-1. However, the minimum number of seed/siliquae of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on number of seed/siliquae of mustard crop.

The maximum weight of siliqua per plant of mustard crop was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum weight of siliqua per plant of mustard crop was recorded from date of sowing at 30 November. The maximum weight of siliqua per plant of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum weight of siliqua per plant of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on weight of siliqua per plant of mustard crop.

The maximum weight of seed / plant of mustard crop was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum weight of seed / plant of mustard crop was recorded from date of sowing at 30 November. The maximum weight of seed / plant of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum weight of seed / plant of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on weight of seed / plant of mustard crop.

The maximum test weight of mustard crop was recorded from date of sowing at 15 October which were statistically higher with date of sowing at 5 October. Although, the minimum test weight of mustard crop was recorded from date of sowing at 30 November. The maximum test weight of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum test weight of mustard crop was recorded from control plot.

Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on test weight of mustard crop.

The maximum grain yield of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum grain yield of mustard crop was recorded from date of sowing at 30 November. The maximum grain yield of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum grain yield of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on grain yield of mustard crop.

The maximum straw yield of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum straw yield of mustard crop was recorded from date of sowing at 30 November. The maximum straw yield of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum straw yield of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on straw yield of mustard crop.

The maximum biological yield of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum biological yield of mustard crop was recorded from date of sowing at 30 November. The maximum biological yields of mustard crop were documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically at par with soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum biological yields of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on biological yields of mustard crop.

The maximum harvest index of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum harvest index of mustard crop was recorded from date of sowing at 30 November. The maximum harvest index of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} which were statistically at par with soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum harvest index of mustard crop was recorded from control plot. Accordingly, the interaction effect of date of sowing and soil application of granule sea weed extract of mustard crop does not show significant results on harvest index of mustard crop.

The maximum B:C ratio of mustard crop was recorded from date of sowing at 15 October followed by with date of sowing at 5 October. The minimum B:C ratio of mustard crop was recorded from date of sowing at 30 November. The maximum B:C ratio of mustard crop was documented from soil

application of granule sea weed extract 25 kg ha^{-1} followed by soil application of granule sea weed extract 20 kg ha^{-1}. However, the minimum B:C ratio of mustard crop was recorded from control plot.

Discussion

Growth and development studies on crop: In these experiments, the results exhibited that the 5 October date of sowing most effective enhanced growth parameter plant height. The maximum plant height was recorded from date of sowing at 5 October which were statistically at par with date of sowing at 15 October. The maximum plant height at 60, 90 DAS and harvest stage was documented from soil application of granule sea weed extract 25 kg ha-1 which were statistically higher than soil application of granule sea weed extract 20 kg ha^{-1}. This could be happened because to the source of adequate amount of humic acid and other micro nutrients assistance to increase height of plant. These have provided abundant opportunity to produce and accumulate more photosynthates which could be more helpful to harvest significant increase in various growth, yield attributes and yield. These results are accordance with the finding are Tripathi *et al.,* (2011) Jadhav *et al.,* (2009). Singh *et al*., (2014) Gupta *et al*., (2017) [7], Biswajit *et al.*, (2013) [3].

Yield attributes and yield: It is evidently understood from data that the yield attributes *viz*; number of siliqua/ plants, siliqua length, number of seed/siliquae, weight of siliqua, weight of seed / plant and test weight of mustard crop was recorded maximumfrom date of sowing at 15 October which were statistically at par with date of sowing at 5 October. The maximum grain yield of mustard crop was recorded from date of sowing at 15 October which were statistically at par with date of sowing at 5 October. Although, the minimum grain yield of mustard crop was recorded from date of sowing at 30 November. This could be happened because initial favourable temperature in the month of October and sufficient soil moisture accelerates the nutrient uptake and results increased plant growth and development. Which ultimately provided abundant opportunity to produce and accumulate more photosynthates which could be more helpful to harvest significant increase in various growth, yield attributes and yield. Kumari and Koteshwara Rao (2005) [11], Rathore *et al.*, (2009).

Economics

The maximum net return of mustard crop was recorded from date of sowing at 15 October followed by with date of sowing at 5 October. However, the maximum net return of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} followed by soil application of granule sea weed extract 20 kg ha^{-1}.

The maximum B:C ratio of mustard crop was recorded from date of sowing at 15 October followed by with date of sowing at 5 October. The minimum B:C ratio of mustard crop was recorded from date of sowing at 30 November. However, the maximum B:C ratio of mustard crop was documented from soil application of granule sea weed extract 25 kg ha^{-1} followed by soil application of granule sea weed extract 20 kg ha^{-1}. Pattam *et al.,* (2017).

Table 1: Effect of date of sowing and seaweed extract on Plant population, Plant height, Number of branches, Siliqua/plant and Siliqua length

Treatments	Plant Population	Plant Height				Number of branches		siliqua/ plants	Siliqua length
		45 DAS	60 DAS	90 DAS	Harvest	Primary	Secondary		
(A.) Date of sowing									
5 October	15.515	19.878	65.153	142.675	143.565	4.56	7.643	282.598	6.308
15 October	15.623	18.905	58.658	134.098	134.773	34.695	8.383	288.305	8.440
30 November	15.803	16.598	52.340	124.003	124.968	4.183	5.448	266.445	7.738
C.D.	N/A	0.828	2.621	5.998	6.045	0.208	0.113	6.765	0.367
SE(m)	0.177	0.205	0.650	1.488	1.499	0.052	0.080	2.166	0.091
SE(d)	0.251	0.290	0.919	2.104	2.120	0.073	0.113	2.478	0.129
B. Sea weed extract									
Control	15.577	18.177	56.003	130.250	131.123	4.243	6.710	274.300	7.287
15 kg ha-1 granule sea weed extract	15.607	18.337	57.607	132.200	133.060	4.353	6.973	277.517	7.407
20 kg ha-1 granule sea weed extract	15.673	18.510	58.713	134.423	135.183	4.500	7.350	280.660	7.553
25 kg ha-1 granule sea weed extract	15.730	18.817	61.473	137.493	138.373	4.823	7.597	283.987	7.733
C.D.	N/A	N/A	2.736	1.00	0.95	0.204	0.343	1.89	0.321
SE(m)	0.328	0.282	0.914	2.884	2.903	0.068	0.114	5.911	0.107
SE(d)	0.232	0.399	1.292	2.039	2.052	0.096	2.339	3.180	0.152
Interaction (AxB)									
SE(d)±	0.569	0.691	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C.D at 5%	N/A	N/A	2.238	4.995	5.027	0.167	0.280	6.238	0.263

Table 2: Effect of date of sowing and seaweed extract on Number of seed / siliqua, Weight of Siliqua/plant, Weight of seed / plant, Test weight, Grain yield (Kg/ha), Straw yield (Kg/ha), Biological yield (Kg/ha), Harvesting index (%), B:C ratio

Treatments	Number of seed/siliqua	Weight of Siliqua/plant	Weight of seed/plant	Test weight	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Biological yield (Kg/ha)	Harvesting index (%)	B:C ratio
(A.) Date of sowing									
5 October	14.550	21.728	1.640	4.773	18.820	74.185	93.004	20.213	1:2.440
15 October	18.775	26.378	1.858	5.435	20.550	75.100	95.650	21.454	1:2.718
30 November	16.595	18.490	1.483	3.180	16.998	72.140	89.938	18.883	1:1.901
C.D.	0.805	1.097	0.079	0.215	0.910	3.14	4.286	0.957	N/A
SE(m)	0.200	0.272	0.020	0.053	0.226	0.838	1.063	0.237	N/A
SE(d)	0.283	0.385	0.028	0.076	0.319	1.185	1.503	0.336	N/A

B. Sea weed extract									
Control	15.727	20.473	1.610	4.307	17.273	73.047	90.320	19.100	1:2.393
15 kg ha-1 granule sea weed extract	16.540	21.517	1.630	4.403	18.043	73.947	91.990	19.593	1:2.383
20 kg ha-1 granule sea weed extract	16.880	22.613	1.670	4.503	19.237	74.123	93.360	20.570	1:2.433
25 kg ha-1 granule sea weed extract	17.413	24.190	1.730	4.637	20.603	75.183	95.786	21.470	1:2.487
C.D.	0.724	0.999	0.074	0.206	0.849	2.21	3.64	0.907	N/A
SE(m)	0.242	0.472	0.035	0.069	0.401	1.105	1.388	0.303	N/A
SE(d)	0.342	0.334	0.025	0.097	0.284	0.563	1.964	0.428	N/A
Interaction (AxB)									
SE(d)±	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C.D at 5%	0.592	0.817	0.061	0.168	1.519	2.819	3.401	0.742	N/A

Conclusion

On the basis of our finding it is concluded that the Date of sowing (15 October) and Seaweed extract (granule sea weed extract 25 kg ha^{-1}) shows the best result in the term of Growth, Yield, Yield attribute and Economics.

References

1. Afroz MM, Sarkar MAR, Bhuiya MSU, Roy AK. Effect of sowing date and seed rate on yield performance of two mustard varieties. J Bangladesh Agril. Univ. 2011;9(1):(5-8).
2. Bhuiyan MS, Mondol MRI, Rahaman MA, Alam MS, Faisal AHMA. Yield and yield attributes of rapeseed as influenced by date of planting. International Journal of Sustainable Crop Production. 2008;3(3):25-29.
3. Biswajit Pramanick B, Brahmachari K, Ghosh A. Effect of seaweed saps on growth and yield improvement of green gram. African Journal of Agricultural Research. 2013;8(13):1180-1186.
4. Gangwal, Giri G. Influences of irrigation and time of nitrogen application on mustard [*Brassica jumcea Cass*]. Indian J Agron. 2011;33(1):154-158.
5. Grewal KS, Godara OP, Malik RS. Effect of motivation application of mustard on quality and New Zealand update in soils of Southern Haryana. Journal of Agronomy. 2009;25(½):43-47.
6. Gajghane PG, Toncher SS, Rout MM. Effect of potassium and sulphur levels on soil Fertility Status after harvest of mustard Department of Agronomy, Post Graduate Institute, Dr. P.D.K.V., Akola – 444001 (Maharashtra). 2015;15(1):347-351.
7. Gupta Meenakshi, Charu Sharma, Rajeev Sharma, Vikas, Khushu MK. Effect of sowing time on productivity and thermal utilization of mustard (*Brassica juncea*) under sub-tropical irrigated conditions of Jammu. Journal of agrometeorology. 2017;19(2):137-141.
8. Husain MF, Ravinder Kumar. Influence of sowing dates and application of zinc on the performance of mustard in South-West semi arid zone of Uttar Pradesh. Internat. J agric. Sci. 2006;2(2):601-604.
9. Kumar Anil, Bikram Singh, Yashaial, Yadav JS. Effect of sowing time and crop geometry on tetra loculor Indian mustard under southwest Haryana. Indian J Agric. Sci. 2004;74(11):594-596.
10. Kurmi K. Influence of sowing date on the performance of rapeseed and mustard varieties under rainfed situation of Southern Assam. J. Oilseeds Res. 2002;19(2):197-198.
11. Kumari CR, Koteswararao DS. Effect of land treatments and dates of sowings on growth parameters of mustard (*Brassica juncea*). Journal of Oilseeds Research. 2005;22(1):188-189.
12. Kumar Santosh, Verma SK, Singh TK, Singh Shyambeer. Effect of nitrogen and sulphur on growth, yield and nutrient uptake by Indian mustard (*Brassica juncea*) under rainfed condition. Indian Journal of Agricultural Sciences. 2011;81(2):145-149.
13. Kumar H, Yadav DS. Effect of phosphorus and sulphur levels on growth yield and quality of Indian mustard (*B. juncea*) cultivars. Indian J Agron. 2007;52:154-157.
14. Kumar Rajesh, Singh RP, Yesh Pal. Yield and quality of Brassica species as influenced by different dates of sowing and varieties. Pantnagar Journal of Research, 2008, 6(1).
15. Lone NA, Mir MR, Payne WA, Khan AV, Dilshada Tabassum, Mir S, *et al*. Effect of phosphorus and potassium on yield quality characteristics of mustard. Applied Biological Research. 2010;12(2):78-80.
16. Maurya KL, Singh MV, Pandey VP, Singh SK. Effect of nitrogen and varieties on growth and yield of mustard. Haryana Journal of Agronomy. 2004;20(1/2):132-134.
17. Mishra SK. Effect of sulphur and potassium on yield nutrient uptake and quality characteristics of mustard (*B. juncea* L.) in UdicHaplu steps of Kanpur. Journal of the Indian society of soil Science. 2003;51(14):544-548.