Int.J.Curr.Microbiol.App.Sci (2017) *6*(4): 1168-1177

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 4 (2017) pp. 1168-1177**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.604.143

Yield, Nitrogen Uptake and Nutrient Use Efficiency in Indian Mustard (*Brassica juncea* [L.]) As Effected by Date of Sowing and Nitrogen Levels in Western Haryana, India

P. Keerthi*, R.K. Pannu, A.K. Dhaka, John Daniel and Yogesh

Department of Agronomy, College of Agriculture, CCS Haryana Agricultural University, Hisar 125004, India
*Corresponding author

Keywords

Seed yield, Nitrogen uptake, Nutrient use efficiency, Date of sowing and nitrogen.

Article Info

Accepted:
12 March 2017
Available Online:
10 April 2017

A B S T R A C T

The present study was undertaken during 2013-14 and 2014-15 at Chaudhary Charan Singh research farm Hisar, to find out the effect of date of sowing and nitrogen levels on growth, yield, nitrogen uptake and nutrient use efficiencies in western Haryana. The results revealed that plant height, dry matter accumulation, Siliquae per plant, number of seeds of siliqua and 1000 seed weight decreased with each delay in sowing. The seed yield decreased by 39.8 and 38.7 % over November 15, 24.2 and 24.5% over November 5, 6.89 and 7.50 over October 25 in October 15 (2683 and 2586 kg/ha) during both 2013-14 and 2014-15, respectively. The nitrogen use efficiency decreased by 39.2 and 37.9 % over November 15, 24.4 and 24.6 over November 5, 6.75 and 7.22 % over October 25 in October 15 sown crop during 2013-14 and 2014-15, respectively. Increased doses of nitrogen application also increased the plant height, dry matter accumulation, siliquae per plant, Number of seeds of siliqua and 1000 seed weight significantly. Nitrogen application responded seed and biological yields significantly up to 100 kg N/ha. The maximum total N (82.4 and 79.3 kg/ha) uptake was recorded with the application of 100 kg N/ha during 2013-14 and 2014-15, respectively and decreased with decreasing dose of nitrogen.

Introduction

In India oilseed crops are the important component of the agricultural economy, next to food grains, in terms of area, production and value. Rapeseed-mustard (*Brassica spp.*) is a major group of oilseed crops of the world with second largest acreage in India after China. Indian mustard alone accounts for 65 per cent of total *rabi* oil seed crops. Rapeseed-mustard contributed 24.5 % in total oilseed production in the country, whereas, Haryana alone contributed 10.2 % of total rapeseed-mustard production. In India it is cultivated on 6.70 million hectares with production of 7.96 mt with productivity of 1188 kg/ha in 2013-14.The production is almost stable during last five years. However, the consumption has increased from 12.6 mt in 2005-06 to 19.0 mt in 2013-14. The gap in demand and supply is being bridged by import of edible oil, which has increased from 4.3 mt in 2005-06 to 9.2 mt in 2013-14 (Anonymous, 2014). Haryana is one of the major rapeseed and mustard growing states and the crop occupied 5.40 lakh ha of area producing 8.8 lakh tonnes giving an average yield of 1639 kg/ha during 2013-14

(Anonymous, 2014). Among several factors causing low productivity, lack of suitable time of sowing is a crucial aspect in ultimate success of mustard commercial crop. As sowing time is one of the most important non monetary input affecting crop yield and other agronomic traits. Sowing either too early or too late has been reported unfavorable Uzan *et al.,* (2009). Sowing time is very important for mustard production (Mondal *et al*., 1999). Late sown Indian mustard is exposed to high temperature coupled with high evaporative demand of the atmosphere during reproductive phase (ripening and grain filling) which consequently results in forced maturity and low productivity. The time of sowing is the main factor which decides the environmental conditions of a crop is likely to encounter during its growing period, timing and rate of organ appearance. One month delay in sowing from mid October resulted in loss of 40.6% in seed yield Lallu *et al*., (2010). It suffers from exposure to low temperature during vegetative and early pod filling stage and relatively higher temperature during germination and maturity by Adak and Chakravarthy (2010). Temperature cannot be manipulated easily under field conditions but seeding time can be so adjusted that the various physiological stages of the crop can coincide with specific (most suitable) temperature during crop growth cycle, which is the most essential non-monetary input for obtaining higher production.

Plant nutrition is a key input to increase the productivity of mustard crop. Among the major nutrients, nitrogen which is insufficient in most of the Indian soils plays an important role in *Brassica* crops. Nitrogen is considered to be the most important nutrient for the crop to activate the metabolic activity and transformation of energy, chlorophyll and protein synthesis. Nitrogen also affects uptake of other essential nutrients and it helps in the better partitioning of photosynthates to reproductive parts which increase the seed: stover ratio (Singh and Meena, 2004). Since mustard crop is highly elastic, its canopy architecture is bound to alter by nutrients and it may affect light interception and carbon dioxide assimilation besides competing for moisture, nutrients, light and it may reduce drastically seed yield and quality. Reddy and Sinha (1989) reported that seed yield increased linearly up to 96.5% by increasing nitrogen dose and in comparison to no nitrogen. There is an ample scope for increasing the yield of Indian mustard through fertilizer use, especially nitrogen (Tandon, 1989). In view of the above factors, the present investigation was undertaken at Research farm, CCSHAU, Hisar to study the Yield, nitrogen uptake and nitrogen use efficiency in Indian mustard (*Brassica juncea* [L.]) as effected by date of sowing and nitrogen levels in Western Haryana.

Materials and Methods

The present investigation was carried out at the research farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar during r*abi* (winter) seasons of 2013-14 and 2014-15. Hisar is located in Indogangetic plains of North-West India at 215.2 meters above mean sea level with a latitude of 29°10ˈ North and longitude of 75°46ˈ East. Hisar has a semi-arid climate with hot and dry desiccating winds accompanied by frequent dust storms of high velocity in summer, severe cold during winter and humid warm during monsoon rainy months. The maximum temperature sometimes exceeds 45°C during summer, while temperature below freezing point accompanied by frost in winter is usually experienced in this region. The annual rainfall is about 459 mm and the total rainfalls as well as its distribution are subjected to great variations. The soil of the experimental field was sandy loam, having 0.57% organic carbon and pH 8.73. It was low in available N

(155 kg /ha), medium in available P_2O_5 (23.2 kg /ha) and rich in available K_2O (395.6 kg/ha). The experiment consisting of four dates of sowing *viz*. October 15, October 25, November 5 and November 15 in main plots and five nitrogen levels *viz*. 0 kg N/ha (Control), 40 kg N/ha, 60 kg N/ha, 80 kg N/ha and 100 kg N/ha in sub plots was laid out in split plot design with three replications. The doses of nitrogen were applied in the form of urea. Half dose of the recommended nitrogen was applied as basal dose and remaining half as top dressing after 1st irrigation during both the seasons. Indian mustard cv. RH 0749 was sown with the help of seed drill in rows 30 cm apart at a rate of 5 kg N/ha. Crop was sown as per treatments. The plant samples were analyzed using standard procedures. N content in seed and straw at harvest was determined. For analysis of N oven dried plant material (seed and straw at harvest) from each plot were grinded separately with grinder. The methods for analysis were Nesslers reagent method (Linder, 1944) for nitrogen in seed and straw, uptake of these nutrients was calculated as kilogram per hectare by multiplying the contents with seed and straw yields in different treatments respectively. The agronomic efficiency (AE), physiological efficiency (PE) apparent recovery efficiency (AR) and nitrogen use efficiency (NUE) were calculated using standard methods (Fageria and Baligar, 2003).

$$\text{AE (kg seed/kg nutrient applied)} = \frac{\text{Yf - YC}}{\text{Na}}$$

$$\text{PE (kg biological yield/kg nuteint uptake)} = \frac{\text{BYf - BYc}}{\text{NUf - NUc}}$$

$$\text{AR (\% of nutrient taken up by a crop)} = \frac{\text{NUf - NUc}}{\text{Na}} \times 100$$

$$\text{NUE (kg seed/kg nutrient applied)} = \frac{\text{Yf}}{\text{Na}}$$

In the above expressions, Yf and Yc are the yields (kg/ha) in fertilized and control plots, respectively. BYf and BYc are the biological yields (kg/ha), respectively, NUf and NUC are the amounts of nutrients taken up by a crop in fertilized and control plots, respectively and Na refers to the amount of nutrient applied (kg/ha). Data collected during the study were statically analyzed by using the technique of analysis of variance (ANOVA) described by Cochran and Cox (1959). To judge the significant difference between means of two treatments, the critical difference (CD) was calculated at 0.05 probability level.

Results and Discussion

Growth parameters

Growth parameters such as plant height and dry matter accumulation at harvest were significantly affected by date of sowing during both the years (Table 1). The crop has sown on 15 October produced significantly higher growth characters viz. plant height, dry matter accumulation per plant compare to 25 October, 5 November and 15 November. Earlier sown crop (October 15 and 25) faced favourable soil moisture condition and relatively warmer temperature during vegetative phase and conducive temperature during 50% flowering and pod formation stage, while later sown crop (November 5 and 15) faced low temperature at the time of emergence as well as at 50% flowering stage. The early sown crop (October 15 and 25) might be maintained better plant relations like leaf water potential (LWP) and higher turgor potential which led to higher rate of photosynthesis due to more opening of stomata for longer period of time. This has also increased for faster cell division and enlargement, which leds to higher growth rate Kumar *et al*., (2013).

The increase in nitrogen dose increased the plant height and dry matter accumulation significantly upto 100 kg N/ha at maturity. Maximum reduction was observed in control plots and maximum at 100 kg N/ha and the same further declined during second year of experimentation. Poor growth in control treatment may be due to low availability of plant nutrient which are necessary for the normal growth. Nitrogen being the basic constituent of chlorophyll, protein and cellulose required for the process of photosynthesis and tissue formation for proper growth (Maereka *et al.*, 2007). The yield attributes siliqua/plant, siliqua length, seed yield/ plant, seed yield, and stover yield decreased significantly with the crop sown on after 25 October in both the years. However, 15 and 25 October sowings were at par (Table 1). Maximum number of Seeds/siliqua was recorded with 15 October which was superior to 5 and 15 November.

Yield attributes and yield

The yield attributes siliqua/plant and seed yield decreased significantly with the crop sown on after 25 October in both the years. However, 15 and 25 October sowings were at par (Table 1). Maximum number of seeds/siliqua was recorded with 15 October which was superior to 5 and 15 November. Test weight and biological yield decreased significantly with delay in sowing from 15 October to 15 November (Table 1). The delay in sowing from October 15 to 25, October 15 to November 5, October 15 to November 15 decreased the seed yield of mustard by about 6.89, 24.2, 39.8, during 2013-14 and 7.50, 24.5, 38.7 during 2014-15, respectively. This decrease was because of decrease in number of siliquae per plant by 5.5, 9.7, 31.5 % during first year and 6.1, 10.7, 33.7 % during second year, respectively. And also the decrease in number of seeds per siliqua by 3.7, 5.2, 8.2 % during first season and 3.2, 4.8, 6.4 % during second season, respectively, similarly there was a decrease in test weight by 4.5, 8.9, 23.9 % during first year and 4.5, 9.1, 24.2 % during second year, respectively. The stronger source is required for the stronger sink. The higher biological yield was found significantly associated with higher seed yield of mustard (r=0.96).This clearly shows the biological yield increased by any input or management practice will automatically increase the seed yield of mustard. The seed yield of mustard can also be estimated through biological yield with the regression equation (Fig. 1, Seed yield = -851.5+0.303 biological yield, r^2= 0.92). Early (October 15 and 25) sown crop received the optimum environment conditions required for better crop growth in terms of plant height and dry matter accumulation. The significantly positive association between biological yield with growth parameters namely plant height (r= 0.95) and dry weight (r=0.96).

Nitrogen application had significant effects on yield attributes and yield. Yield attributes viz. siliquae/plant and number of seeds/siliqua were significantly increased with increasing level of N up to 40 kg N/ha (Table 1), which remained at par with 60, 80 and 100 kg N/ha. Maximum test weight was recorded with 100 kg N/ha which was superior to 40 and 0 kg N/ha. Seed yield, increased significantly with increase in doses of nitrogen from 0 to 100 kg

N/ha, whereas biological yield increased significantly up to 80 kg N/ha, which remained at par with 100 kg N/ha (Table 1). The significantly higher seed yield (109 and 120 %) and biological yield (43.7 and 45.4 %) in 100 kg N/ha over control because of more availability of nutrients for their growth and development of better yield attributes and yield.

Nutrient content and uptake by crop

The nitrogen content in seed was 2.87 and 2.83 times higher than in stover of Indian mustard crop. It was not influenced by the different dates of sowing during both the years of study (Table 2). Nitrogen uptake in seed and stover decreased significantly with delay in sowing. Maximum nitrogen uptake by seed (38.2 kg/ha) and stover (46.7 kg/ha) was recorded with first date of sowing *i.e.* October 15 which was significantly differed with other treatments.

The data on total uptake of nitrogen also followed same trend as observed in its uptake in seed and stover and decreased with each delay in sowing during both the years of study. The nitrogen uptake was more through the stover (55.55 % of total N) than seed (44.4 % of total N). The higher N uptake in stover was because of higher stover yield. The higher N uptake in early sown crop was due to higher seed and stover yield during both the years. This fact can be also be fortified with highly significant positive relationship between biological yield and N uptake (r=0.97).Similarly highly significant relationship between seed yield and N uptake (r=0.96). The N uptake can be computed with regression equation fitted with biological yield as BY=2219+119.3 N uptake, r^2 =0.94, (Fig. 2).

Nitrogen content in seed increased significantly with increased dose of nitrogen during both the years of study. Maximum nitrogen content in seed was observed with highest dose of nitrogen *i.e*. 100 kg N/ha which was significantly higher than over 80, 60, 40 and 0 kg N/ha.

However, nitrogen content in stover was not influenced with increased nitrogen doses during both the years of study. The nitrogen uptake by the seed, stover and total was significantly affected by doses of nitrogen. Maximum nitrogen uptake by the seed, stover and total was in 100 kg N/ha followed by 80, 60, 40 and 0 kg N/ha during both the years of study. The higher uptake of N in straw and seed under higher dose of N was because of more availability of these nutrients, which encouraged the crop growth and finally higher seed and biomass yields (Table 2). The nutrient status of plant tissue being the genetic character was affected less by the environment but, higher growth require higher uptake (Reager *et al*., 2006).

Nutrient use efficiency

The agronomic efficiency, physiological efficiency, apparent recovery and nutrient efficiency were more during 2013-14 than 2014-15. This was mainly because of seed yield, biological yield and higher N uptake higher during 2013-14 than 2014-15 (Table 3). The agronomic efficiency, apparent recovery and nitrogen use efficiency decreased significantly with delay in sowing during both the years, but the physiological efficiency was not affected by date of sowing.

Among the doses of nitrogen, agronomic efficiency and nutrient use efficiency decreased significantly with increased doses of nitrogen. Whereas, the maximum physiological efficiency and apparent recovery was observed in 40 kg N/ha which was at par with 60 and 80 kg/ha during both the years.

Table.1 Effect of sowing time and nitrogen levels on yield attributes and yields of Indian mustard

Treatments	Plant height (cm)		Dry weight (g) per plant		Siliquae/plant		Number of seeds per siliqua		1000 seed weight (g)		Seed yield (kg/ha)		Biological yield (kg/ha)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Time of sowing														
Oct 15	227.6	225.7	148.9	141.1	384.6	376.8	13.4	12.4	*6.7*	6.6	2683	2586	12020	11636
Oct 25	224.2	220.4	133.9	128.5	363.4	353.7	12.9	12.0	6.3	6.3	2498	2392	11232	10864
Nov 5	220.2	216.3	126.7	118.6	347.2	336.2	12.7	11.8	6.1	6.0	2033	1951	9503	9119
Nov 15	209.1	207.9	112.3	111.0	263.2	249.5	12.3	11.6	6.0	5.8	1614	1585	7797	7414
CD (P=0.05)	**2.1**	**1.9**	**2.2**	**1.4**	**55**	**53**	**0.4**	**0.5**	**0.3**	**0.3**	**214**	**208**	**741**	**579**
Nitrogen levels (kg/ha)														
0 kg N/ha	212.7	209.9	115.3	113.9	248.5	238.7	11.5	11.1	5.6	5.6	1277	1182	8005	7641
40 kg N/ha	214.2	211.2	125.7	120.7	343.9	330.1	12.7	11.7	6.0	6.0	2069	1987	9373	8989
60 kg N/ha	221.0	218.7	132.5	126.6	357.1	347.0	13.0	12.0	6.3	6.3	2410	2344	10595	10212
80 kg N/ha	225.8	222.4	137.2	129.1	368.3	357.8	13.3	12.3	6.5	6.5	2597	2523	11217	10833
100 kg N/ha	227.7	225.6	142.2	133.6	380.3	371.5	13.5	12.5	6.9	6.8	2681	2608	11500	11116
CD (P=0.05)	**1.9**	**2.5**	**2.0**	**1.3**	**37**	**38**	**0.4**	**0.4**	**0.5**	**0.5**	**68.5**	**67.4**	**446**	**445**

Table.2 Effect sowing time and nitrogen levels on N content and its uptake by Indian mustard

Treatments	Nitrogen content (%)				Nitrogen uptake (kg/ha)					
	Seed		Stover		Seed		Stover		Total	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Time of sowing										
Oct 15	1.41	1.40	0.498	0.494	38.2	36.2	46.7	44.9	84.8	81.1
Oct 25	1.38	1.37	0.482	0.476	34.9	32.9	42.3	40.5	77.2	73.5
Nov 5	1.36	1.35	0.469	0.472	27.9	26.4	35.2	34.0	63.1	60.4
Nov 15	1.33	1.31	0.459	0.468	21.6	20.9	28.5	27.4	50.1	48.3
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**2.9**	**2.7**	**3.4**	**2.8**	**3.8**	**2.9**
Nitrogen levels (kg/ha)										
0 kg N/ha	1.30	1.29	0.443	0.439	16.7	15.2	29.9	28.8	46.6	44.0
40 kg N/ha	1.37	1.35	0.470	0.468	28.5	26.9	34.5	33.0	63.0	60.0
60 kg N/ha	1.38	1.37	0.481	0.478	33.5	32.1	39.5	37.7	73.0	69.9
80 kg N/ha	1.39	1.38	0.491	0.487	36.4	34.9	42.5	41.2	78.9	76.0
100 kg N/ha	1.41	1.39	0.502	0.499	38.0	36.5	44.4	42.8	82.4	79.3
CD (P=0.05)	**0.01**	**0.01**	**NS**	**NS**	**0.9**	**0.8**	**2.0**	**2.2**	**2.4**	**2.5**

Table.3 Effect of sowing time and nitrogen levels on Agronomic efficiency, physiological efficiency, apparent recovery and nutrient use efficiency of Indian mustard

Treatments	Agronomic efficiency (kg/kg)		Physiological efficiency (kg/kg)		Apparent recovery (%)		Nutrient use efficiency (kg/kg)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Time of sowing								
Oct 15	21.2	21.3	87.4	87.8	49.3	47.6	45.9	44.3
Oct 25	19.8	19.7	89.9	96.3	45.8	44.0	42.8	41.1
Nov 5	14.9	15.1	99.5	100.8	37.7	37.2	34.7	33.4
Nov 15	13.4	14.3	88.6	89.4	28.4	28.1	27.9	27.5
CD (P=0.05)	**3.4**	**2.7**	**NS**	**NS**	**10.6**	**10.1**	**3.6**	**3.3**
Nitrogen levels (kg/ha)								
0 kg N/ha	19.8	20.1	78.2	79.2	41.0	40.0	51.7	49.7
40 kg N/ha	18.9	19.4	97.3	98.9	44.0	43.1	40.1	39.1
60 kg N/ha	16.5	16.7	94.0	98.5	40.3	40.1	32.5	31.5
80 kg N/ha	14.0	14.3	95.8	97.6	35.8	33.7	26.8	26.1
100 kg N/ha	**1.4**	**1.3**	**7.8**	**15.3**	**4.1**	**3.9**	**1.3**	**1.2**

Fig.1 Regression line showing the relationship of biological yield (kg/ha) with seed yield (kg/ha)

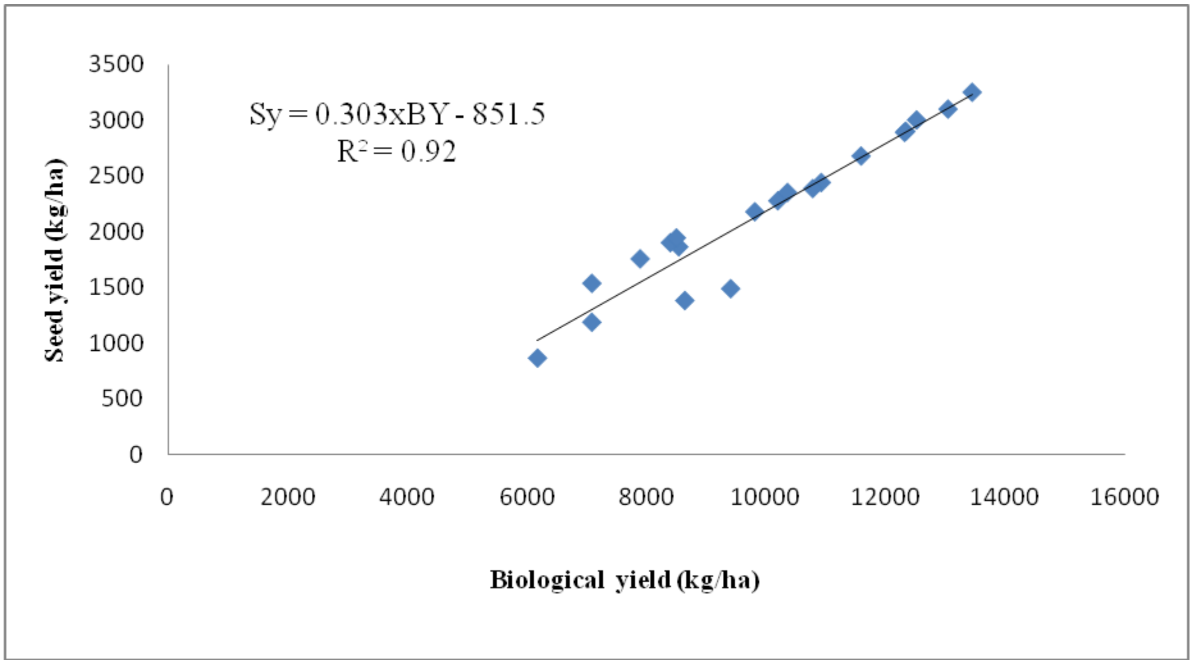
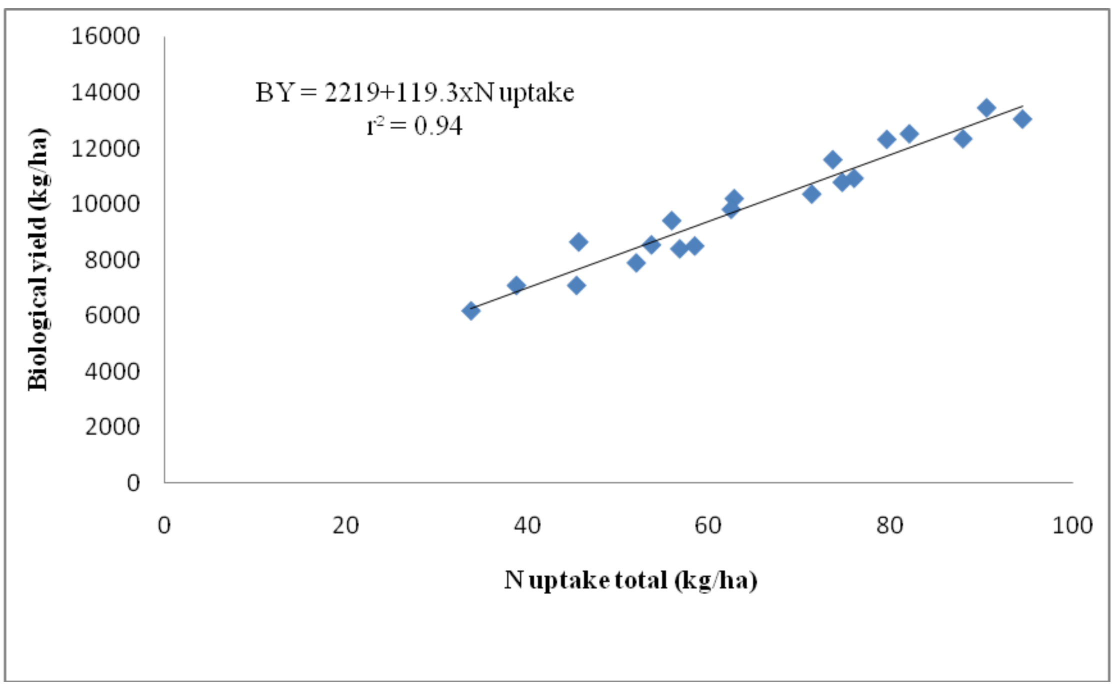


Fig.2 Regression line showing the relationship of N uptake (kg/ha) with biological yield (kg/ha)



The minimum physiological efficiency was found in 0 kg N/ha which was significantly lower than the higher doses of nitrogen and the minimum apparent recovery was found in 100 kg N/ha which was significantly lower than 80, 60 and 40 kg N/ha. Early sowing resulted in increase in agronomic efficiency and apparent recovery because of higher increase in seed yield and higher nutrient uptake with the application of nitrogen during both the years. The maximum agronomic efficiency, apparent recovery and nutrient use efficiency was recorded in control treatment *i.e.* 0 kg N/ha, whereas physiological efficiency was recorded highest with 40 kg N/ha. The highest efficiency in control might be due to more efficient utilization of nitrogen than all other treatments. This higher efficiency was mainly because of more uptake of nutrient in this treatment relative to higher doses of the same source (Table 3). The increase in nitrogen dose decreased the agronomic efficiency, apparent recovery and nutrient use efficiency because of comparatively low uptake and low seed yield and biological yield this fact can be explained by law of diminishing returns (Tedon *et al*., 2014). Based on the results of two year study during 2013-14 and 2014-15 it can be concluded that crop sown on October 15 with 100 kg N/ha performed significantly better growth, yield attributes and yield. The agronomic efficiency, apparent recovery and nutrient use efficiency of mustard crop was significantly decreased with delay in sowing but physiological efficiency was not influenced by different dates of sowing during both the years. Among the nitrogen doses, the agronomic, physiological, apparent recovery and nutrient use efficiency decreased significantly with increased dose of nitrogen under western Haryana.

References

Adak, T. and Chakravarthy, N.V.K. 2010. Quantifying the thermal heat requirement of Brassica in assessing biophysical parameters under semiarid microenvironment. *Int. J. Bimeteorol.*, 54(4): 365-377

Anonmyous. 2014. *www.Indiastat.com*.

Cochran, W.G. and Cox, G.M. 1955. *Experimental Designs*, John Willey Pub., New York.

Fageria, N.K. and Baligar, V.C. 2003. Methodology for evaluation of lowland rice genotypes for nitrogen use efficiency. *J. Plant Nutrition,* 26(1): 315–33.

Kumar, S., Sairam, R.K. and Prabhu, K.V. 201). Physiological traits for high temperature stress tolerance in *Brassica Juncea*. *Indian J. Plant Physiol*., 18(1): 89-93.

Lallu, R.S., Baghel, V.S. and Srivastava, S.B.L. 2010. Assessment of mustard genotypes for thermo tolerance at seed development stage. *Ind. J. Plant Physiol*., 15(1): 36-43.

Linder, R C. 1944. Rapid analytical methods for some of the more common inorganic constituents of plant tissues. *Plant Physiol.*, 19: 76-78.

Maereka, E.K., Madakadze, R.M., Mashingaidze, A.B., Kageler and Nyakanda, C. 2007. Effect of nitrogen fertilization and timing of harvesting on leaf nitrate content and taste in mustard rape (*Brassica juncea* L.Czern). *J. Food, Agri. Environ.*, 5(3and4): 288-293.

Mondal, R.I., Biswas, M., Hyder, A.M.K. and Akbar, M.A. 1999. Response of rapeseed genotypes to seed rate and seeding date. *Bangladesh J. Agri. Res.*, 24(1): 83-90.

Reager, M.L., Sharma, S.K. and Yadav, R.S. 2006. Yield attributes, yield and nutrient uptake of Indian mustard (*Brassica juncea*) as influenced by nitrogen levels and its split application in arid western Rajasthan. *Indian J. Agron.*, 51(3): 213-216.

Reddy, B.N. and Sinha, M.N. 1989. Integrated fertilizer and water management to boost mustard production. *Indian Farming*, 39(5): 5-6.
Singh, A. and Meena, N.L. 2004. Effect of nitrogen and sulphur on growth, yield attributes and seed yield of mustard (*Brassica juncea*) in eastern plains of Rajasthan. *Indian J. Agron.*, 49(3): 186-188.
Tandon, H.L.S. 1989. Crop responses and economics. (In) *Secondary and Micro-nutrient recommendations for Soils and Crops*-A Guide Book, pp. 8-9, 33-43. Fertiliser Development and Consultation Organization. New Delhi.
Tedone, I., Verdini, L., Grassano, N., Tarraf, W. and Mastro, G.D. 2014. Optimizing nitrogen in order to improve the efficiency, eco-physiology, yield and quality on one cultivar of durum wheat. *Italian J. Agron.*, 9: 49-54.
Uzun, B., Zengin, U., Furat, S. and Akdesir, O. 2009. Sowing date effects on growth, flowering, seed yield and oil content of canola cultivars. *Asian J. Chem.*, 21: 1957-1965

How to cite this article:

Keerthi, P., R.K. Pannu, A.K. Dhaka, John Daniel and Yogesh. 2017. Yield, Nitrogen Uptake and Nutrient Use Efficiency in Indian Mustard (*Brassica juncea* [L.]) As Effected by Date of Sowing and Nitrogen Levels in Western Haryana. *Int.J.Curr.Microbiol.App.Sci.* 6(4): 1168-1177. doi: https://doi.org/10.20546/ijcmas.2017.604.143