Journal of Oilseed Brassica, 7 (2) : 174-179, July 2016

Effect of dates of sowing and nitrogen levels on nutrient uptake (kg/ha), nutrient use efficiency, and quality of Yellow Sarson (*Brassica rapa* var. *trilocularis*) grown in rice fallow

Rinjumoni Dutta and Joshila Enghipi

Department of Agronomy, Assam Agricultural University, Jorhat-785013, India
Corresponding author: rinjumonidutta@gmail.com
(*Received: 2 July 2016: Revised: 6 July 2016; Accepted: 6 July 2016*)

Abstract

A field experiment was conducted at Assam Agricultural University, Jorhat during the *Rabi* season of the year 2013-2014 with a view to study the effect of dates of sowing, and nitrogen levels on nutrient uptake, nutrient use efficiency, and quality of Yellow Sarson (*Brassica rapa* var. *trilocularis*) grown in rice fallow. The treatments comprised of three different dates of sowing i.e. D_1: 25th November, D_2: 5th December, and D_3: 15th December, and five doses of nitrogen i.e., N_0: 0 kg N/ha, N_1: 20 kg N/ha, N_2: 40 kg N/ha N_3: 60 kg N/ha and N_4: 80 kg N/ha. Experimental findings revealed that delay in sowing of the crop from 25th November lead to a significant reduction in the growth, and yield attributing characters that consequently lead to yield reduction. NPK content and uptake in seed and stover also reduced with delay in crop sowing. Oil content, N uptake by seed, and P, K uptake by stover, total K uptake, and nitrogen use efficiency were significant up to 60 kg N/ha. Available N and P content in soil after the harvest of the crop was recorded highest at 80 kg N/ha.

Key words: *Nutrient uptake, nutrient use efficiency, oil content, Rice fallow, Yellow Sarson*

Introduction

Oilseed crops are the second most important determinant of agricultural economy, next to cereals accounting for 5% of the gross national product and 10% the value of all the agricultural commodities. Although, India occupies a prominent position in terms of acreage, and production on oilseed map of the world yet there is still a gap between production potential and actual realization.

Yellow Sarson is mainly grown in Assam, Bihar, Orissa, and West Bengal as *Rabi* crop. Out of the several reasons responsible for low productivity is non-adoption of good agronomic practices like optimum date of sowing, and fertilizer application. The optimum time of sowing for rapeseed and mustard crop is middle of October to middle of November but very often the farmers have to sow the crop late due to delayed monsoon rain, and late harvesting of *Kharif* crops resulting in poor yield. Delay in sowing reduces the yield due to its depressing effect on the plant growth, flowering duration, seed formation and productivity (Bali *et al.*, 2000). In India, rapeseed-mustard is the second most important edible oilseed after soybean. Fertilizer application is of paramount importance as fertilizer application contributes significant increase in yield of rapeseed-mustard crop. Inadequate supply of nutrients particularly of nitrogen leads to low productivity. Nitrogen is considered to be the most important nutrient for the crop to activate the metabolic activity, and transformation of energy as well as chlorophyll, and protein synthesis. Nitrogen also affects the uptake of other essential nutrients, and it helps in better partitioning of photosynthates to reproductive parts which increases the seed-stover ratio, and enhances the yield of rapeseed-mustard group of crops. However, information regarding scientific production technology particularly dates of sowing in rice fallow, and application of fertilizer nitrogen on Yellow Sarson is lacking in this region. Keeping these facts in view, it is felt that generation of information on performance of rapeseed crop under delay situation in rice fallow with optimum dose of application of nitrogen seems to be important.

Materials and Methods

The experiment was carried out during the *Rabi* season of 2013-14 in the Instructional-cum Research Farm of Assam Agricultural University, Jorhat, Assam, India which is situated at 26°47' N latitude, and 94°12' E longitude, and at an elevation of 86.6 m above the mean sea level. The experimental site was sandy loam in nature, acidic in reaction (5.6), medium in organic carbon (0.57%), medium in available N (296.87 kg/ha), and low in available Phosphorus (21.28 kg/ha), and potassium (93.71 kg/ha). The experiment was laid out in split plot design with three replications. The treatments consists of three dates of sowing (25th Nov, 5th Dec and 15th Dec), and five levels of nitrogen (0, 20, 40, 60, 80 kg/ha), respectively. Well decomposed FYM @ 2t/ha was uniformly broadcasted over the experimental area, and thoroughly incorporated with soil at the time of final land preparation. A uniform dose of 30kg P_2O_5/ha in the form of single superphosphate, and 30kg K_2O/ha in the form of muriate of potash (MOP) along with half dose of N as urea as per treatment were applied one day before sowing and incorporated into the soil. The remaining half dose of N was top dressed as per treatment, 21 days after sowing. The applied fertilizer was mixed properly with the soil. The seeds of Yellow Sarson variety "Benoy" were sown on 25 November, 5 December, 15 December 2013 @ 10kg/ha. The crop which was sowed on 25th November, 5th December, and 15th December 2013 was harvested on 25th February, 4th March, and 14th March 2014, respectively. The estimated oil yield in kilogram per hectare was worked out multiplying the per cent oil content in seed by the respective seed yield in kilogram per hectare

Agronomic efficiency (AE)

It was express as the additional amount of economic yield (seed) per unit of nitrogen applied.

$$AE = \frac{\text{Yield in fertilized plot (kg/ha) - Yield in control plot (kg/ha)}}{\text{Quantity of fertilizer applied (kg/ha)}}$$

Apparent recovery

The apparent nitrogen recovery efficiency (ANR) has been used to reflect plant ability to acquire applied nitrogen form soil, and expressed in percent.

$$ANR = \frac{\text{Nitrogen uptake in fertilized plot – Nitrogen uptake in control plot}}{\text{Quantity of nitrogen applied}}$$

RESULTS AND DISCUSSION

Seed yield and stover yield (kg/ha)

Data presented in Table 1 revealed that the seed, stover yield, and harvest index of yellow sarson

Table1: Effect of dates of sowing and levels of nitrogen on yield (kg/ha), Oil content (%), oil yield (kg/ha) and protein content (%) of Yellow Sarson

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Oil content in seed (%)	Oil yield (kg/ha)	Protein content (%)
Dates of sowing					
25th November (D_1)	724.71	2036.52	34.83	256.20	12.91
5th December (D_2)	532.29	1681.70	33.08	179.72	12.17
15th December (D_3)	391.59	1385.54	32.29	129.01	11.84
SEm±	9.87	25.21	0.18	3.60	0.05
CD (P=0.05)	38.73	98.96	0.72	14.14	0.20
Nitrogen doses (kg/ha)					
0 (N_0)	330.13	1259.97	29.62	98.60	10.90
20 (N_1)	445.50	1493.95	32.09	144.68	11.79
40 (N_2)	570.72	1787.74	34.16	196.91	12.38
60 (N_3)	695.06	1950.25	35.66	248.81	13.15
80 (N_4)	706.26	2014.34	35.49	252.58	13.31
SEm±	9.99	31.70	0.44	4.26	0.08
CD (P=0.05)	29.17	95.52	1.30	12.44	0.23

Table 2: % NPK-content in seed, and stover, nitrogen, phosphorus, potassium uptake by seed, stover, and their total uptake of Yellow Sarson as affected by dates of sowing, and levels of nitrogen

Treatments	N-Content (%)		N-uptake (kg/ha)		Total N Uptake (kg/ha)	P Content (%)		P-Uptake (kg/ha)		Total P uptake (kg/ha)	K-Content (%)		K-uptake (kg/ha)		Total K uptake (kg/ha)
	Seed	Stover	Seed	Stover		Seed	Stover	Seed	Stover		Seed	Stover	Seed	Stover	
Dates of sowing															
25th November (D_1)	2.066	0.239	15.17	5.00	20.17	0.48	0.053	3.63	1.09	4.72	0.30	0.51	2.21	10.47	12.68
5th December (D_2)	1.947	0.202	10.61	3.51	14.11	0.46	0.051	2.55	0.87	3.42	0.28	0.47	1.48	7.98	9.46
15th December (D_3)	1.894	0.172	7.59	2.46	10.05	0.45	0.048	1.84	0.69	2.53	0.27	0.44	1.08	6.15	7.23
S.Em±	0.008	0.007	0.19	0.10	0.22	0.003	0.001	0.05	0.02	0.06	0.002	0.01	0.03	0.14	0.17
C.D.(P=0.05)	0.033	0.029	0.73	0.41	0.86	0.02	0.002	0.20	0.06	0.24	0.01	0.03	0.12	0.57	0.67
Nitrogen doses (kg/ha)															
0 (N_0)	1.743	0.149	5.84	1.92	7.76	0.34	0.046	1.14	0.58	1.72	0.26	0.44	0.90	5.57	6.47
20 (N_1)	1.887	0.174	8.52	2.67	11.19	0.43	0.048	1.90	0.72	2.62	0.27	0.46	1.24	6.95	8.19
40 (N_2)	1.980	0.205	11.42	3.75	15.17	0.45	0.051	2.60	0.92	3.52	0.28	0.47	1.63	8.51	10.14
60 (N_3)	2.105	0.237	14.71	4.72	19.43	0.54	0.054	3.79	1.06	4.85	0.29	0.49	2.04	9.73	11.77
80 (N_4)	2.130	0.255	15.11	5.23	20.34	0.55	0.055	3.93	1.14	5.06	0.30	0.50	2.16	10.23	12.39
S.Em.±	0.013	0.011	0.21	0.17	0.29	0.005	0.001	0.05	0.03	0.06	0.01	0.01	0.03	0.32	0.32
C.D.(P=0.05)	0.037	0.031	0.60	0.49	0.84	0.01	0.003	0.13	0.09	0.17	NS	NS	0.12	0.94	0.94

declined significantly for every 10 days delay in sowing of the crop from 25th November (D_1) to 15th December (D_3). The extent of decrease in yield of seed was 26.55% to 45.96% for 10 and 20 days delay in sowing from 25th November. In case of stover yield the extent of reduction was 17.42% to 31.96%, respectively. Significant reduction in yield due to delay in sowing of the crop (October to December) in different parts of the country was reported by several workers like Alam *et al*. (2014), and Dinda *et al.* (2015).

Application of nitrogen resulted in significantly higher seed and stover yield as well as harvest index over the control. The seed and stover yield increased significantly with increasing doses of nitrogen from 0kg N/ha (N_0) to 80kg N/ha (N_4). However, the difference between 60kg N/ha (N_3), and 80kg N/ha (N_4) in respect of seed yield, and stover yield was statistically at par.

Seed oil content (%) and oil yield (kg/ha)

Data presented in Table 1 revealed that the seed oil content and oil yield of rapeseed also declined significantly for every 10 days delay in sowing of the crop from 25th November (D_1). The extent of decrease was more when the crop was sown beyond 15th December (D_3). Delay in sowing from normal time resulting reduction in seed oil content was observed by Sattar *et al*. (2013). In late sown crop generally the seed protein content increases which may be the cause for reduction in seed oil content. Such observation was recorded by Jain *et al.* (1998) in case of four varieties of *B. juncea* in a field trial at Gwalior (UP), India.

The oil content in seed increased significantly due to nitrogen application up to 60kg N/ha (N_3) beyond which oil content declined. On the other hand oil yield increased with increasing doses of nitrogen up to 80 kg N/ha (N_4) through the effect was not significant beyond 60 kg N/ha (N_3). Decrease in oil content with higher doses of nitrogen might be due to the utilization of photosynthetic material in protein synthesis. As per pathway of degradation, carbohydrates are degraded to acetyl Co-A which is used for the synthesis of fatty acid by using acetyl carrying protein result the higher oil content in seed. Improvement of oil content at 60 kg N/ha might be due to improved nitrogen availability in the root zone as well as nitrogen content in the plant system as a whole, leading to enhanced translocation especially of N, P, and K to reproductive structures, and plant parts. Since oil yield per hectare is the resultant of seed yield and oil per cent, the oil yield increased significantly due to nitrogen application up to 60 kg N/ ha because of increase in seed yield. The results are in agreement with the findings of Reager *et al.* (2010).

Nitrogen content (%) and uptake (kg/ha)

Data presented in Table 2 revealed that the nitrogen content in seed, and stover was found to decrease due to delay in sowing of the crop. The decreased nutrient content in seed and stover resulted in decrease nitrogen uptake with delay in sowing of the crop. Bhatnagar (1999) also reported that nutrient uptake decreased considerably with delayed sowing.

Per cent nitrogen content in seed and stover, and protein content in seed as well as nitrogen uptake by seed, stover, and total uptake increased due to application of nitrogen. The highest N-uptake was found under the doses 80 kg N/ha (N_4) which was statistically at par with 60 kg N/ha (N_3). This may be due to the fact that increased of application nitrogen up to the above level probably increased the availability of nitrogen in the soil helping in better uptake of nitrogen but further higher dose might have caused nutrient imbalance restricting the uptake. Many other workers found that with the increase in the doses of nitrogen application, the nitrogen content as well as the nitrogen uptake increased. Increase uptake of nitrogen was also reported by Kumar *et al.* (2011). The highest uptake with 80 kg N/ha could be due to the highest total biomass yield, relatively higher nutrient concentration, higher nutrient mobility and its absorption.

Phosphorus content (%) and uptake (kg/ha)

Data presented in Table 2 revealed that the phosphorus content in both seed, and stover was found to decrease due to delay in sowing of the crop. The decreased nutrient content in seed, and stover resulted in decrease phosphorus uptake with delay in sowing of the crop.

Phosphorus content in seed, and stover as well as phosphorus uptake by seed, stover, and total uptake were found to be significant due to graded doses of nitrogen. The 80 kg N/ha recorded the highest phosphorus content in seed, and stover, phosphorus uptake in seed, and stover, and its total uptake. However, the differences between 60, and 80 kg N/ha on effect of phosphorus content, and uptake by stover were non-significant. This might be due to the fact that nitrogen also helps in absorption and utilization other nutrients like phosphorus. Increase the phosphorus content, and as well as the phosphorus uptake was also reported by Reager *et al.* (2010), Baro (2013) in rapeseed and mustard.

Potassium content (%) and uptake (kg/ha)

Data presented in Table 2 revealed that the potassium content in both seed, and stover was found to decrease due to delay in sowing of the crop. The decreased nutrient content in seed and stover resulted in decrease nitrogen uptake with delay in sowing of the crop.

Application of different doses of nitrogen could not produce any difference in per cent potassium content in seed, and stover but their uptake increased significantly up to 60 kg N/ha. Baro (2013) recorded the highest potassium uptake by rapeseed at 80kg N/ha.

Available N, P and K-content at harvest

Data furnished in Table 3 revealed that the available N, P_2O_5 and K_2O in soil recorded at harvest of the crop was increase with delay in sowing of the crop which might be the resultant of the decreasing trend of uptake of nutrients by the crop sown at different dates. These findings are in conformity to those of Kalita and Bora (2003).

Available N and P_2O_5 were influenced significantly due to different doses of nitrogen, while the highest values was recorded with application of 80 kg N/ha. Similar results were also reported by Thakuria (2011). However, different doses of nitrogen could not bring about any significant differences in respect of available K_2O content in soil at harvest of Yellow Sarson. A similar result was also recorded by Chetia (2003) in sunflower.

Table 3: Available N, P and K (kg/ha) content at harvest of Yellow Sarson as influenced by dates of sowing and doses of nitrogen

Treatments	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Dates of sowing			
25th November (D_1)	281.40	19.97	85.70
5th December (D_2)	292.27	21.85	86.49
15th December (D_3)	305.24	22.22	87.53
S.Em±	0.97	0.16	0.82
CD (P=0.05)	3.79	0.65	NS
Nitrogen doses (kg/ha)			
0 (N_0)	266.24	19.25	83.70
20 (N_1)	280.85	20.66	85.18
40 (N_2)	290.60	21.67	86.30
60 (N_3)	310.12	22.30	87.83
80 (N_4)	317.08	22.85	89.28
SEm±	2.38	0.16	1.40
CD (P=0.05)	6.94	0.46	NS
Interaction (D×N)			
SEm±	4.12	0.27	2.43
CD (P=0.05)	NS	NS	NS

NS= Non-significant

Table 4: Agronomic efficiency (kg seed/kg nitrogen) and apparent recovery (%) of applied nitrogen

Treatment	Agronomic efficiency (kg seed/kg nitrogen)	Apparent recovery of nitrogen (%)
Nitrogen doses (kg N/ha)		
20 (N_0)	5.77	17.16
40 (N_1)	6.01	18.53
60 (N_2)	6.08	19.45
80 (N_3)	4.70	15.73

Nitrogen use efficiency

Nitrogen use efficiency in terms of agronomic efficiency and apparent recovery of applied nitrogen were assessed and presented in Table 4. Among different doses of nitrogen, 60 kg N/ha (N_3) recorded the highest value in respect of agronomic efficiency as well as apparent recovery of nitrogen. These findings are in agreement with the observation made by Kumar *et al.* (2011), Thakuria (2011), and Baro (2013).

References :

Alam Md M, Begum F, Roy P. 2014. Yield and yield attributes of rapeseed-mustard (*Brassica* sp.) genotypes grown under late sown condition. *Bangladesh J Agril Res* **39**: 311-336.

Bali AS, Shah MH, Hasan B. 2000. Effect of plant density on Brown Sarson (*B. campestris* subsp. *oleifera* var. *Brown Sarson*) under different levels of nitrogen and phosphorus. *Indian J Agron* **45**: 174-178.

Baro R. 2013. Response of Yellow Sarson (*B. rapa* var. *trilocularis*) to nitrogen and phosphorus under rainfed condition. M.Sc. (Ag.) Thesis, Assam Agricultural University, Jorhat, Assam, India.

Chetia B. 2003. Effect of levels of nitrogen and phosphorus on sunflower (*Helianthus annus* L.). M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat, Assam, India.

Dinda NK, Ray M, Sarkar P. 2015. Effect of sowing date vis-à-vis variety of rapeseed and mustard on growth, yield and aphid infestation in gangetic plains of West Bengal. *All Intl Biannual J Environ Sci* **9**: 21-24.

Jain KK, Chauhan YS, Khandekar MP, Jain PC. 1998. Effect of sowing dates and genotypes on yield and yield attributing traits in Indian mustard. *Madras Agril J* **76**: 241-246.

Kalita HC, Bora PC. 2003. Effect of dates of sowing and fertility management on nutrient uptake by rainfed rapeseed (*B. campestris*). *J Agril Sci Socy North-East India*. **16**: 110-115.

Kumar S, Verma SK, Singh TK, Singh S. 2011. Effect of nitrogen and sulphur on growth, yield and nutrient uptake by Indian mustard (*B juncea*) under rainfed condition. *Indian J Agril Sci* **81**: 145-149.

Reager ML, Sharma SK, Narolia GP. 2010. Effect of nitrogen levels and its split application on nutrient content and quality of Indian mustard (*B juncea*) in arid Western Rajasthan. *Annals Agril Res* **31**: 96-101.

Sattar A, Cheema MA, Wahid MA, Saleem MF, Ghaffari MA, Hussain S, Arshad MS. 2013. Effect of sowing time on seed yield and oil contents of canola varieties. *J Global Innovation Agril & Social Sci* **1**: 1-4.

Thakuria C. 2011. Effect of sowing method and nitrogen level on Yellow Sarson (*B. rapa* var. *trilocularis*) under rainfed condition. M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat, Assam, India.