Indian Journal of Agronomy **47** (2) : 249–254 (June 2002)

Evaluation of promising varieties of Ethiopian mustard (*Brassica carinata*) and Indian mustard (*Brassica juncea*) at different fertility levels under rainfed conditions

DHANANJAI SINGH, ARVIND KUMAR AND R.P. SINGH

Department of Agronomy, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttaranchal 263 145

Received : September 2001

ABSTRACT

A field experiment was conducted during the winter seasons of 1996–97 and 1997–98 at the Crop Research Centre, Pantnagar, to study the effect of different fertility levels on yield attributes, seed yield, haricots index, oil content and oil yield of promising *Brassica* varieties. Branches/plant (31.86), seed weight/plant (4.75 g), 1,000-seed weight (4.4 g), seeds/siliqua (9.7) and seed yield (1,350 kg/ha) were highest in 'PBC 9221'('Kiran') of *Brassica carinata* A.Braun whereas harvest index (16.7%) was lower in this variety. Oil content of 'Kranti' *Brassica juncea* (L.) Czernj. & Cosson was higher but oil yield was higher in 'BC 9221' *Brassica carinata*. Variety 'DLSC 1' had higher FUE (N) (43.6) and 'Kranti' recorded lower (1.7) FUE (N) compared with 'PR 8988'. With each successive increase in fertility level up to 125% of the recommended, the FUE (N) increased. With the application of fertilizer, oil content decreased and, contrary to it, oil yield increased owing to higher seed yield of pronounced yield-contributing attributes.

Key words : *Brassica* spp., Fertility levels, Performance, Rainfed

Wide variations in the growth behaviour and maturity of *Brassicas* result in differential requirements of fertilizers, particularly nitrogen which also affect the uptake of other essential nutrients. Nitrogen is the most limiting nutrient element in most of the Indian soils. This is particularly true for rapeseed-mustard which are mostly grown under resource constraint. Balanced fertilization, especially nitrogen is essential for achieving higher seed yields. With the introduction of new varieties, it becomes imperative to study their performance at varying levels of fertilization particularly under rainfed situation.

MATERIALS AND METHODS

The present field investigation was carried out on silty clay-loam soil at the Crop Research Centre, Pantnagar, during the winter seasons of 1996–97 and 1997–98 under rainfed conditions. The experiment was laid out in randomized block design, The experimental field was rich in organic

matter (1.21%) and potassium (265.0 kg/ha) and medium in phosphorus content (73.62 kg/ha) and was neutral in reaction (pH 7.0). The recommended fertilizer dose was 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha. A uniform basal application of whole amount of phosphorus in the form of single superphosphate and whole amount of potassium in the form of muriate of potash along with three-fourth quantity of nitrogen through urea were applied as per the treatment. Remaining quantity of N was top-dressed after 1 month. Five plants were tagged from each plot randomly and used for recording branches/plant, seed weight/plant, 1,000-seed weight and seeds/siliqua. Oil content in seeds was also determined using NMR technique. Oil yield was computed form the data on seed yield /ha and oil %. Nitrogen content in plant parts was determined using micro-Kjeldahl. The FUE (N) was calculated by total N uptake.

RESULTS AND DISCUSSION

Yield attributes

Different varieties and fertility levels had significant influence on branches/plant (Table 1). Variety 'PBC 9221' had maximum branches. The number of branches increased up to 125% of the recommended fertility level. Seed weight/plant was significantly higher in 'PBC 9221', which was at per with 'DLSC 1'. 'Kranti' had lowest seed weight/plant. The seed weight/plant was maximum at 125% of the recommended fertility level.

Different varieties and fertility levels influenced the 1,000-seed weight significantly. 'PBC 9221' had significantly higher 100-seed weight over 'DLSC 1' but the 2 Indian varieties 'Kranti' and 'PR 8988' remained at par. Variety 'DLSC1'

Table 1. Influence of varieties and fertility levels on yield attributes, seed yield, harvest index, oil content and oil yield of *Brassica* spp. under rainfed conditions (pooled data of 1996–97 and 1997–98)

Treatment	Branches/ plant	Seed weight/ plant (g)	1,000-seed weight (g)	Seeds/ siliqua	Seed yield (q/ha)	Harvest index (%)	Oil content (%)	Oil yield (q/ha)
Variety								
Brassica carinata								
'PBC 9221' ('Kiran')	31.86	4.75	4.4	9.7	1,350	16.7	40.3	5.4
'DLSC 1'	16.75	4.72	4.1	9.6	1,220	17.0	39.5	4.8
Brassica juncea								
'PR 8988'	13.48	4.50	4.3	10.4	1,020	24.3	41.3	4.2
'Kranti'	10.96	3.98	4.2	9.5	930	23.0	42.0	3.9
CD (P=0.05)	1.42	0.41	0.2	0.6	67	2.2	0.4	0.6
Fertility levels								
50% of Recommended	10.42	3.23	3.8	8.3	840	15.7	41.8	3.5
75 % of Recommended	17.75	4.32	4.1	9.7	1,090	21.8	40.9	4.5
Recommended	19.42	4.60	4.5	10.9	1,270	21.1	40.6	5.2
125 % of Recommended	20.47	5.79	4.7	10.3	1,320	22.5	40.3	5.3
CD (P=0.05)	1.42	0.41	0.2	0.6	67	2.2	0.4	0.6

Recommended fertility level: 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha

had lowest value but was at par with Indian mustard.

Seed/siliqua and 1,000-seed weight increased up to recommended fertility level. Seeds/siliqua were significantly higher in 'PR 8988'.

Seed yield, oil content and oil yield

Different varieties and fertility levels significantly influenced the seed yield, harvest index, oil content and oil yield. Variety 'PBVC 9221' had significantly higher seed yield over other varieties, followed by 'DLSC 1'. The yield increase in this variety was 9.6, 31.1 and 24.4 % over 'DLSC 1', 'Kranti' and 'PBC 8588'. Both the varieties of *Brassica carinata* had significantly more seed yield than of Indian mustard varieties. Amongst the Indian mustard varieties, 'PR 8988' recorded higher seed yield. Variety 'PR 8988' had higher harvest index than the other varieties, but was on a par with 'Kranti'. With successive increase in fertility level, seed yield and harvest index increased significantly up to recommended fertility level and thereafter increase was non-significant.

The seed yield increase at 125% of the recommended fertility level was 36.4, 17.4 and 3.8 % over 50% of recommended, 75% of recommended and recommended fertility levels respectively.

Oil content in 'Kranti' was the highest followed by 'PR 8988' and lowest oil content was recorded in 'DLSC 1'. 'DLSC 1' had also lowest 1,000-seed weight. However, 'PBC 9221' gave significantly more oil yield in comparison with other varieties owing to better seed yield.

Higher oil content in seeds was recorded at lower fertility levels, and with each successive increases in fertility level the oil content reduced. Lowest oil content in seed was recorded at 125 % of the recommended fertility level. Contrary to oil content, oil yield increased significantly up to 125 % of the recommended fertility level. This may be due to the fact that increasing availability of nitrogen increased the proportion of proteinous substances in the seeds (Kumar,1992).

According to general pathway of degradation, carbohydrates are degraded to acetyl Co A that are used for the synthesis of fatty acid by using acetyl-carrying protein (ACP) resulting in higher oil content in seeds. Although, higher rates of fertilizer application resulted in reduced oil in seeds, it increased the yield/ha significantly.

Since oil yield/ha is the resultant of seed yield and oil %, the oil yield/ha also increased due to fertilizer application up to 125 % of recommended fertility level because of increase in seed yield. These findings confirm results of Kumar and Singh (1987) and Shukla and Kumar (1992).

Nitrogen content and its uptake

Different varieties and fertility levels influenced the nitrogen content in vegetative plant parts significantly at different stages of crop growth. Nitrogen % in vegetative plant part was higher in early stages of crop growth and declined thereafter with advancement of crop age. The reduction in N content with age of the crop was, however, more conspicuous

Table 2. Nitrogen content (%) in plant at various growth stages, in leaves at 60-day stage, in stover, seeds and siliqua husk at harvest as influenced by varieties and fertility levels under rainfed conditions (Data pooled over 1996–97 and 1997–98)

Treatment	Nitrogen content (%) in						
	Plant (DAS)			Leaves		At harvest	
	30	60	90	60 DAS	Stover	Seeds	Siliqua husk
Variety							
Brassica carinata							
'PBC 9221' ('Kiran')	3.2	1.7	1.2	2.2	0.7	2.4	1.2
'DLSC 1'	3.3	1.8	1.3	1.9	0.8	2.2	1.4
Brassica juncea							
'PR 8988'	3.4	1.9	1.4	2.1	0.9	1.5	1.6
'Kranti'	3.4	1.8	1.4	2.2	0.9	1.5	1.5
CD (P=0.05)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Fertility levels							
50% of Recommended	2.6	1.4	0.7	1.8	0.4	1.2	1.2
75 % of Recommended	3.0	1.7	1.0	1.9	0.7	1.6	1.3
Recommended	3.6	2.0	1.6	2.3	1.0	2.0	1.5
125 % of Recommended	4.0	2.3	2.0	2.5	1.3	2.6	1.7
CD (P=0.05)	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Recommended fertility level: 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha; DAS, days after sowing

Table 3. Nitrogen uptake by stover, seeds and siliqua husk and total N uptake at harvest, comparative nitrogen-use efficiency as influenced by *Brassica* varieties and fertility levels under rainfed conditions (Data pooled over 1996–97 and 1997–98)

Treatment	Stover	Seeds	Siliqua husk	Total N uptake (kg/ha)	Comparative NUE (%)
Variety					
Brassica carinata					
'PBC 9221' ('Kiran')	6.4	22.8	10.9	40.1	15.1
'DLSC 1'	13.5	20.6	13.0	47.1	43.6
Brassica juncea					
'PR 8988'	8.4	13.6	14.8	36.8	1.7
'Kranti'	8.7	13.6	14.1	36.4	-
CD (P=0.05)	0.7	0.7	0.5	1.0	-
Fertility levels					
50% of Recommended	8.9	11.6	10.9	31.4	-
75% of Recommended	6.3	15.3	12.0	33.6	14.7
Recommended	9.3	18.9	14.0	42.2	36.0
125 % of Recommended	12.6	24.4	16.1	53.0	48.0
CD (P=0.05)	0.7	0.7	0.5	1.0	-

between 30 and 60 days stages (Table 2).

Variety 'PBC 9221' recorded significantly lower N content than all other varieties at all the stages but was at par with 'DLSC 1'. At 90-day stage 'Kranti' had higher value but was at par with 'PR 8988' and 'DL SC 1'. The leaves of variety 'ADLSC 1', at 60 day stage, had significantly lower N content than the other varieties, while varieties 'PBC 9221' and 'PR 8988', being at par, had higher N content in leaves at 60-day stage than 'Kranti' and 'DL SC 1'. The seeds of 'PBC 9221' had significantly higher N content than other of varieties. Variety 'PR 8988' and 'Kranti', being at par, had significantly lower N content in seeds than other varieties. The siliqua husk of 'Kranti' recorded significantly higher N content than the other varieties and 'PBC 9221' had lower N content.

With each successive increase in fertility levels, there was a significant increase in N content up to 125 % of recommended fertility level. Nitrogen uptake by stover, seeds, siliqua husk and total uptake at harvest were significantly influenced due to different varieties and fertility levels (Table 3). Variety 'DLSC 1' had maximum N uptake and 'PBC 9221' recorded the lowest uptake by stover. The seeds of variety 'PBC 9221' showed significantly higher N uptake, followed by 'DLSC 1'. The siliqua husk of 'Kranti' showed significantly higher and of 'PBC 9221' significantly lower N uptake than the other varieties. The total N uptake of 'DLSC 1' was higher and of 'PR 8988' lower under rainfed conditions. However, 'PR 8988' was on a par with 'Kranti'.

With every successive increase in fertility level, up to 125 % of the recommended fertility level, there was a significant increase in N uptake.

Total nitrogen uptake remained higher with the application of 125 % of recommended fertility level. Application of N is known to increase the root action exchange capacity, which enhances the nitrogen absorption in plants (Pramanik *et al.*, 1996). There was decrease in N content with the advancement of the crop age under all the fertility levels. This may be due to increase in dry matter at later stages and thus affecting dilution in nitrogen content.

Comparative fertilizer (N)-use efficiency

Different varieties and fertility levels influenced the fertilizer (N)-use efficiency. Variety 'DLSC 1' showed higher nitrogen-use efficiency and 'Kranti' lower (1.7%) compared with 'PR 8988' (Indian mustard). With each successive increase in fertility level up to 125 % of the recommended, the fertilizer (N)-use efficiency increased. Thus there is a need to increase the fertility level of 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha to 75 kg N, 50 kg P_2O_5 and 25 kg K_2O/ha.

REFERENCES

Kumar, Arvind. 1992. Production technology of yield enhancement of Indian mustard under irrigated conditions. *(In) : Advances in Oilseed Research,* vol 1. Kumar, D. and Roy, M, Scientific Publishers, Jodhpur.

Kumar, A. and Singh, R.P. 1987. Performance of promising *toria* entries at varying nitrogen levels. *Annual Research Report, Directorate of Extension*, G.B. Pant University of Agriculture

and Technology Pantnagar.

Pramanik, S.C., Singh, N.P., Singh, S. and Garnayak, L.M. 1996. Irrigation and nitrogen effects on oil yield and nitrogen uptake by Ethiopian mustard *(Brassica carinata). Indian Journal of Agronomy* **41**(1): 101–107.

Saini, J.S., Sahota, T.S. and Dhillon, A.S. 1989. Agronomy of rapeseed and mustard and their place in new and emerging cropping system. *Journal of Oilseeds Research* **6** (2) : 220–267.

Shukla, Anil and Kumar, Arvind. 1992. Studies on seed yield, contribution of different branches and oil development pattern in Indian mustard varieties at varying rates of nitrogen fertilization. *Journal of Oilseeds Research* **9** (1) : 136–143.