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Assessment of Population Dynamics and Mother Crop Nutrition on Seed Yield and Quality in Mustard CV.GM 2

[1]V. Vijaya Geetha, [2]P. Balamurugan and [3]K. Subrahmaniyan
[1]Department of Seed Science and Technology, Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vriddhachalam-606 001, India
[2]Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore-3, India
[3]Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vriddhachalam, India

Corresponding Author: V. Vijaya Geetha, Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Vriddhachalam-606 001, Tamil Nadu, India

ABSTRACT

The optimum number of plants per unit area is an important parameter for getting higher seed yield with quality. Wider spacing due to less plant population and a close spacing due to competitive effect will result in poor yield. Nutrient management is considered to be also an important technology for increasing the productivity of crop plants. Application of nitrogen at the time of flowering leads to increase in seed yield and quality in most of the crops. Phosphorus and potassium favour root growth, fruiting and seed development. Therefore, the present study was conducted with main aim of making available information on optimum plant density per unit area and the nutritional requirement (i.e.) to fix optimum levels of N, P, K fertilizer application of individual seed crop. Significant variations were observed in most of the parameters especially in field emergence, Number of siliqua plant^{-1} and Seed yield due to fertilizer levels and spacing in both the years. Among the fertilizers F_2 registered maximum yield and all the yield parameters. Similar results were obtained with spacing of S_1. Finally from the study it was concluded that the application of 70:40:30 kg NPK ha^{-1} with the spacing of 30×30 cm was found optimum for realizing higher seed yield of 1272 and 1242 kg ha^{-1} during 2005 and 2006.

Key words: Fertilizer, spacing, mustard, seed production, quality seeds

INTRODUCTION

Agricultural productivity depends to a large extent on the sowing quality of the seeds. Quality seed production and distribution have played a vital role in the increased food grain production of our country. Seed quality is multifaceted and influenced by many factors, of which, maintaining optimum plant population is an important factor that contributes to higher yield with least cost involvement. For getting higher seed yield and quality, maintenance of adequate plant density is a vital agronomic factor (Ponnuswamy and Rangasamy, 1996; Chopra and Chopra, 2000). Seed yield obtained from primary, secondary and tertiary spikes and total seed yield obtained with a plant population of 18,518 plants ha^{-1} was significantly higher compared to 13,889 and 27,778 plants ha^{-1} in castor (Sivalakshmi and Reddy, 2006). Row spacing of 30 cm produced significantly higher seed, stover, biological and oil yield, net return and B:C ratio as compared to 45 cm row spacing in Toria (Charak *et al.*, 2006).

The productivity of Indian mustard is low compared to world's productivity, though there is ample scope for its increased production through optimum use of fertilizer. Indian mustard responds to N, P and K nutrients very well. The beneficial effect of N, P and K in increasing the growth attributes of mustard was reported by several workers (Jain *et al*., 1995; Singh *et al*., 1997). Studies on direct effect of N, P and K fertilization on the uptake of nutrients by crops have been found to be helpful in economizing fertilizer use.

Nitrogen is the main source of protein which is required for most of the biochemical processes, regulating growth and development of plants (Hazra and Sinha, 1996). Phosphorus is fascinating plant nutrient, involves in wide range of plant processes right from cell division to development of well developed root system. This nutrient is needed most by young, fast growing tissues and performs a number of functions related to growth, development, photosynthesis and utilization of carbohydrates (Tandon, 1989). Potassium also performs many vital functions in plants such as promoting growth, aiding in translocation, regulating water utilization, improving yield and quality.

Mustard and linseed gave higher seed yield by the application of 30:30:20 kg NPK ha^{-1}. Mandal and Sinha (2004) documented higher plant height, number of branches per plant, number of siliqua per plant, number of seeds per siliquae, 1000 seed weight, seed yield and oil yield of Indian mustard by applying 80:17.2:33.2 kg NPK ha^{-1} along with FYM @10 t ha^{-1}. Keeping in view the above facts, the present study was initiated with the main objective of assessment of the population dynamics, mother crop nutrition and positional effect on seed yield and quality.

MATERIALS AND METHODS

Genetically pure seeds of mustard cv. GM-2 obtained from National Research Centre on Rapeseed and Mustard, Bharatpur, Rajasthan constituted the material for the study. With a view to realize the objectives enumerated in the introduction chapter, the field and laboratory experiments were carried out in the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore between 2004 to 2007. The experimental details and methods adopted are enumerated hereunder.

Effect of fertilizer level and spacing on seed yield and quality: A field experiment was laid out during December 2005 and 2006 to fix optimum levels of N, P, K fertilizer application and spacing for realizing higher yield associated with good quality of seeds in mustard cv. GM-2. The experimental details are furnished hereunder.

Treatments		Fertilizer (NPK kg ha^{-1})		
F_1	-	50: 20: 30		
F_2	-	70: 40: 30		
F_3	-	90: 60: 30		
Treatments		Spacing		
S_1	-	30×30 cm		
S_2	-	45×30 cm		
S_3	-	60×30 cm		
Design: Split plot;		Replications:	Three;	Plot size: 3×3 m

For all the treatments, fertilizers were applied at the time of sowing. Recommended cultural and plant protection measures were followed throughout the crop period.

Field emergence: The total number of plants plot^{-1} were counted on 7th day in each replication and mean values was expressed in number.

Number of siliqua plant^{-1}: Total number of siliqua was counted from ten randomly selected plants individually and average is worked out and expressed as number of siliqua plant^{-1}.

Seed yield ha^{-1}: The seeds were harvested separately plot wise, weighed and computed for unit area and expressed in kg ha^{-1}.

Statistical analysis: The data collected for different parameters from the field and the laboratory experiments were statistically analyzed by the 'F' test for significance as suggested by Panse and Sukhatme (1985). The Critical Difference (CD) was computed at 5% probability. Where ever necessary, the per cent values were first transferred to angular (arc sine) value before analysis.

RESULTS

Significant variations were observed in field emergence due to fertilizer levels and spacing in both the years. Fertilizer level F_2 recorded maximum field emergence of 85 and 83.7% in 2005 and 2006, respectively. Whereas fertilizer level F_3 recorded the minimum of 77.3 in 2005 and 76.3% in 2006. Irrespective of the fertilizer levels, spacing of S_1 recorded highest field emergence of 82.7% in 2005 and 81.7% in 2006. However, it was on par with S_2 (80.7 and 79.7% in 2005 and 2006, respectively) whereas the lowest was registered by spacing at S_3 (79.0%) during 2005 and (77.0%) in 2006. There was no significant difference due to interaction between fertilizer and spacing (Fig. 1).

Marked effect on number of siliqua plant^{-1} was observed due to fertilizer levels and spacing during both the years. F_2 registered the maximum number of siliqua plant^{-1} (233.0 in 2005 and 235.3 in 2006), irrespective of spacing. Between the spacing's, S_1 had significant influence on number of siliqua plant^{-1} during the year 2005 (222.3) and 2006 (229.0) as compared to S_3 (211.0 and 216.3 during 2005 and 2006 rabi, respectively). There was no significant difference due to interaction their during 2005 and 2006 (Table 1).

Seed yield differed due to fertilizer levels and spacings in both the years. Irrespective of spacing, F_2 recorded the maximum seed yield of 1271.8 kg (2005) and 1242.1 kg (2006). In both the years

Table 1: Influence of plant spacing and fertilizer levels on number of siliqua plant^{-1} in mustard cv. GM-2

	Number of siliqua plant^{-1}							
	Rabi 2005				Rabi 2006			
Treatments	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
S_1	221	238	208	222.3	226	241	220	229.0
S_2	213	232	200	215.0	220	235	211	222.0
S_3	208	229	196	211.0	216	230	203	216.3
Mean	214.0	233.0	201.3	216.1	220.7	235.3	211.3	222.4
	F	S	F at S	S at F	F	S	F at S	S at F
SEM	3.677	2.952	5.563	5.114	2.508	2.052	3.835	3.554
CD (p = 0.05)	10.208	6.433	NS	NS	6.964	4.471	NS	NS

F_1 -50:20:30 NPK kg ha^{-1}, F_2 70:40:30 NPK kg ha^{-1}, F_3 90:60:30 NPK kg ha^{-1}, S_1-30×30 cm, S_2 45×30 cm, S_3-60×30 cm, NS: Non significant

Table 2: Influence of plant spacing and fertilizer levels on seed yield hectare^{-1} (kg) in mustard cv. GM-2

	Seed yield hectare^{-1} (kg)							
	Rabi 2005				Rabi 2006			
Treatments	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
S_1	1152.5	1332.8	1020.0	1168.4	1146.7	1294.3	1060.9	1167.3
S_2	1085.5	1261.4	931.9	1092.9	1093.5	1239.4	997.2	1110.0
S_3	1040.0	1221.3	892.9	1051.4	1054.4	1192.6	932.3	1059.8
Mean	1092.7	1271.8	948.2	1104.2	1098.2	1242.1	996.8	1112.4
	F	S	F at S	S at F	F	S	F at S	S at F
SEM	13.140	9.890	19.191	17.131	12.987	10.059	19.262	17.423
CD (p = 0.05)	35.484	21.550	NS	NS	35.059	21.917	NS	NS

F_1-50:20:30 NPK kg ha^{-1}, F_2-70:40:30 NPK kg ha^{-1}, F_3-90:60:30 NPK kg ha^{-1}, S_1 30×30 cm, S_2-45×30 cm, S_3-60×30 cm, NS: Non significant

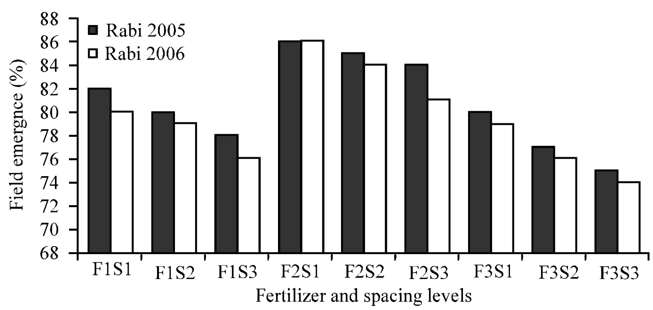

Fig. 1: Influence of plant spacing and fertilizer levels on field emergence percentage in mustard cv. GM-2

fertilizer level at F_3 recorded the minimum (948.2 kg in 2005 and 996.8 kg in 2006). Among the spacings, irrespective of fertilizer levels, S_1 recorded higher seed yield in both 2005 (1168.4 kg) and 2006 (1167.3 kg) than S_3 (1051.4 kg in 2005 and 1059.8 kg in 2006). There was no significant variation due to F×S interaction in both the years (Table 2).

DISCUSSION

Plant population is the basic factor in determining the yield per unit area and its influence on crop yield has been stressed by Rudha and Younis (1978) and Kanade and Karla (1986). In the present study, the increased field emergence (82.7% in 2005 and 81.7% in 2006), plant height and chlorophyll content in closer spacing of 30×30 cmmight be due to the competition for sunlight among the plant density leading to etiolation of internodes for maximum interception of available light energy. The above fact is in agreement with the findings of Weber *et al.* (2003), Johnson and Hanson (2003) and Singh and Dhingra (2004) in mustard. Kumar and Ramesh (2005) in sunflower and Deshmukh *et al.* (2006) in soybean. The role of yield contributing factors such as number of siliqua plant^{-1}, siliqua weight (g), number of seed siliqua^{-1} and seed weight siliqua have to be taken in to account to evaluate the yield potential. The number of siliqua plant^{-1} (222.3 and 229.0 in 2005 and 2006, respectively), seed weight siliqua^{-1}, number of seed siliqua^{-1} and seed yield plant^{-1} were high in 30×30 cm and these attributes recorded lower value in 60×30 cm. The probable reason for increased yield parameters in 30×30 cm could be attributed that optimum spacing provided more opportunity for proper growth and development of individual plants by making available adequate solar radiation, moisture, plant nutrients, space and other growth promoting factors (Jain *et al.*, 1990) resulted in efficient translocation of photosynthates into sink (Gomez *et al.*, 1988). Similar results were reported by Legha and Gajendra (1999) in sunflower, Subrahmaniyan *et al.* (2000) in groundnut, Kabade *et al.* (2006) in sunflower and Charak *et al.* (2006) in toria. In the present study, wider spacing did not influence significantly the yield attributes due to excess availability of plant nutrients which might not have been useful beyond its requirement and have nullified the beneficial effects of wider spacing. This was in conformity with the findings of Jadhav *et al.* (1994) in soybean and Rajasekaran (2001) in niger.

Studies on direct effect of N, P and K fertilization on the uptake of nutrients by crops have been found to be helpful in economizing fertilizer use. In the present investigation, application of 70:40:30 kg NPK ha^{-1} registered maximum field emergence (85.0 and 83.7% during 2005 and 2006, respectively) (Fig. 1), dry matter production, plant height and chlorophyll content. The enhancement of growth characters might be ascribed to the influence of nitrogen, the chief constituent of protein, essential for the formation of protoplasm which leads to cell division and cell enlargement (Bakly, 1974). The results were in accordance with the findings of Balamurugan (1993) in sunflower, Khanpara *et al.* (1993) in mustard, Tiwari and Namadeo (1997) in sesame, Mandal and Sinha (2004) in mustard, Sivalakshmi and Reddy (2006) in castor. From the present investigation, it is also revealed that the application of 70:40:30 kg NPK ha^{-1} recorded higher values for yield attributes like maximum number of siliqua $plant^{-1}$ (233 in 2005 and 236 in 2006) number of seeds $siliqua^{-1}$, siliqua weight and seed weight $siliqua^{-1}$. The increase in the number of seeds per capitulum due to increased application of fertilizer was reported by Gilbert and Tucker (1967) and Singh and Singh (1989) in safflower, Afridi *et al.* (2002) in canola, Khan *et al.* (2002) in Cabbage. The results obtained further draws support from findings of Mahey *et al.* (1989) who reported increased seed weight per capitulum in sunflower. The results obtained further draws support from findings of Mahey *et al.* (1989) who reported increased seed weight per capitulum in sunflower. Nagaraja *et al.* (1996) in linseed and Rajasekaran (2001) in niger also reported higher seed weight per capitilum. This may be due to enhanced photosynthetic activity, as N is a component of chlorophyll, enzymes and membranes (Nevins and Loomin, 1970), causing higher accumulation of metabolites. P, an important constituent of cell nucleus is essential for cell division and development of meristematic tissue, causing stimulatory effect and increasing the number of flower buds (Russell, 1973). Similar findings were obtained by Garnayak *et al.* (2000), Rana and Rana (2003), Ghaffoor *et al.* (2003) in onion, Kaurnad and Sidhu (2004), Barlog and Grzebisz (2004) in mustard and Abdel-Mawgood *et al.* (2005) in snap bean.

From this study, it is concluded that adopting a spacing of 30×30 cm with fertilizer application of 70:40:30 kg NPK ha^{-1} could be optimum for maximizing the yield of high quality seeds in mustard.

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