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Research Paper

Garden cress (*Lepidium sativum*) growth, productivity and nutrient uptake under different sowing dates, row spacing and nitrogen levels

L.R. YADAV[1], SANTOSH CHOUDHARY[2], G.L. KESHWA[3] AND O.P. SHARMA[4]

S.K.N. College of Agriculture, Swami Keshwanand Rajasthan Agriculture University, Jobner, Rajasthan 303 329

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ABSTRACT

An experiment was conducted during two consecutive *rabi* seasons of 2005-06 and 2006-07 to study the effect of sowing date (31 October, 15 and 30 November), row spacing (30 and 40 cm) and nitrogen level (0, 20, 40 and 60 kg/ ha) on productivity of garden cress (*Lepidium sativum* L.) grown on irrigated loamy sand soil. The experiment was carried out in split plot design keeping sowing dates and row spacing in main plots and nitrogen levels in sub plots. Higher dry matter production, leaf area duration, chlorophyll content, seeds/plant, seed (1.78 t/ha), stover (5.22 t/ha) and biological yields (7.00 t/ha), harvest index (25.3%), B:C ratio (2.07) and N (82.9 kg/ha), P (21.6 kg/ha) and K uptake (71.7 kg/ha) was recorded under October 31 sown crop as compared to November 15 and 30 sown crop. Spacing of 40 cm resulted in higher dry matter accumulation, leaf area duration, seeds/plant, seed (1.56 t/ha), stover (4.71 t/ha) and biological yields (6.27 t/ha), B:C ratio, N, P and K uptake as compared to 30 cm wide sown crop. Application of 60 kg N/ha gave significantly higher seed (1.77 t/ha), stover (5.16 t/ha) and biological yields (6.92 t/ha), harvest index (25.42%), B:C ratio (1.98) and N (94.4 kg/ha), P (23.6 kg/ha) and K uptake (73.6 kg/ha) as compared to lower levels.

Key words *:* Garden cress, Nitrogen levels, Row spacing, Sowing dates

More than 90% of the formulations under the Indian system of medicine contain plant based raw materials (Prakasa Rao, 2011). Garden cress (*Lepidium sativum* L.) popularly known as *sialoo, asalia* in Hindi and *chandrasoor* in Sanskrit, is one of the medicinal plants belonging to family Cruciferae. It is antiscorbutic, depurative and stimulant. The seeds of garden cress consist of endosperm (72%) and bran (28%). Mucilage of water soaked seeds is taken for soothing effect. The whole seed which is commonly known to have health promoting properties, contains significant amount of iron, calcium, folic acid and vitamin A and C. Seeds contain 22.5% protein, 27.5% fat and 30.0% dietary fibre. Garden cress is also used against insect-bite and as an insect-repellent in the form of fumigant (Maurice, 1993). It is useful as traditional tonic to increase height of children and also increase the milk production in women and for curing chronic bronchial asthma (Paranjape and Mehta, 2004). Garden cress is also a promising new oilseed crop (Angelini *et al.*, 1997).

[1]**Corresponding author Email:** lalaram69@gmail.com
[1&4]Associate Professor, Department of Agronomy; [2]Ph.D. Scholar; [3]Professor & Dean, S.K.N. College of Agriculture, Jobner

In India, its cultivation is spread in patches across the states of Madhya Pradesh, Uttar Pradesh, Rajasthan, Gujarat and Maharashtra in an area of about 5000 hectares. In Rajasthan, its cultivation is concentrated in tank beds without supplemental irrigation. The traditional method of sowing is to broadcast the seeds after the water has receded in post rainy season. It has low water requirement, not grazed by animals and is not attacked by insect pests. Its cultivation is highly remunerative. The package of agronomic practices for garden cress has not yet been developed. There is an urgent need to develop agronomical practices such as sowing time, plant geometry, fertilizer requirement etc. for obtaining good yield and to provide information to farmers for its cultivation. Sowing time is the most important non-monetary practice affecting growth and yield of a crop. Both early and late sowing results in lower yields. It is, therefore, necessary to find out suitable time of planting which will ensure a balance between vegetative and reproductive phase of garden cress.

The second important package is to provide non-competitive space between the plants as higher plant density adversely affect the growth and development and on the other hand, higher yield per plant obtained under wider

spacing may not compensate the yield to be realized at optimum plant population. The another major constraint limiting production of crop is poor fertility status of soil and nitrogen is one of the major deficient plant nutrients particularly in loamy sand soils of semi-arid region of Rajasthan. An optimum supply of nitrogen is important for vigorous vegetative growth, chlorophyll formation and carbohydrate utilization. The present investigation was, therefore, carried out to optimize the sowing dates, row spacing and nitrogen levels for garden cress.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2005-06 and 2006-07 at Shri Karan Narendra College of Agriculture, Jobner (Jaipur) situated 427 m above the mean sea level at a latitude of 26°05' North and longitude of 75°28' East. The mean annual rainfall at Jobner is 350 mm. The area falls in semi-arid eastern plain zone of Rajasthan. The soils of experimental site had 128.9 kg/ha alkaline permagnate oxidizable nitrogen, 7.4 kg/ha Olsen's available P, 123.7 kg/ha 1 N Ammonium acetate exchangeable K and 0.23% organic carbon. The pH of the soil was 8.2 (1:2 soil water suspension). The experiment was laid out in split plot design with three replications, keeping the combinations of sowing dates (31 October, 15 and 30 November) and row spacing (30 and 40 cm) in main plots, and nitrogen levels (0, 20, 40 and 60 kg/ ha) in sub-plots. Garden cress (locally available seed) was sown @ 12 kg/ ha as per treatments during both the years. The first light irrigation was given immediately after sowing. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. Half dose of nitrogen as per treatments and full dose of phosphorus (20 kg P_2O_5/ha) and potash (15kg K_2O/ha)were applied as basal dose by *pora* method. Remaining half dose of nitrogen was top dressed at second irrigation as per treatment. To keep the crop free from weeds, two manual weeding and hoeing were done, first at 30 DAS and second at 45 DAS. The leaf area was recorded at 30 days interval with the help of portable leaf area meter. The leaf area duration of the crop was calculated by integrating LAI over the growing season of a crop and expressed in days (Power *et al*., 1967).

Plant samples (grain and stover) collected at harvest were sun dried and kept for oven drying for analysis. The nitrogen in samples was estimated by digesting plant samples with H_2SO_4 using hydrogen peroxide. Estimation of nitrogen was done by colorimetric method (Snell and Snell, 1949). Phosphorous content was estimated using vanadomolybdo phosphoric acid to develop yellow colour after wet digestion of plant samples (Jackson, 1973). Potassium content of samples was determined by flame photometer method (Metson, 1956). The chlorophyll content was determined at 50% flowering stage using Spectronic 20 (Arnon, 1949). The data relating to each character were analyzed as per the procedure of analysis of variance as suggested by Panse and Sukhatme (1985). The crop was harvested manually when more than 50% of siliquae changed their colour from green to light yellow. Economics of different treatments was worked out on the basis of input and output on the prevailing market prices and B:C ratio was calculated.

RESULTS AND DISCUSSION

Growth parameters

The growth parameters were significantly influenced by different sowing times. The October 31 sown crop gave significantly higher dry matter accumulation per metre row length indicating an increase of 7.7 and 15.6 % at 30 DAS, 21.5 and 61.3% at 60 DAS and 19.3 and 25.6% at harvest, respectively, over 15 and 30 November sown crop (Table 1). At 30 DAS, dry matter accumulation did not influence due to different row spacing. However, at 60 and 90 DAS and at harvest crop sown at 40 cm spacing fetched significantly higher dry matter accumulation representing an increase of 12.1,10.1 and 8.4%, respectively, over 30 cm row spacing. Nitrogen fertilization significantly increased the dry matter accumulation at all the stages. The mean increase in dry matter accumulation due to application of 20, 40 and 60 kg N/ha was 14.1, 21.4 and 26.5% at 60 DAS, 9.2, 14.5 and 18.7% at 90 DAS and 16.3, 35.2 and 44.5% at harvest, respectively, over control (Table 1).

The sowing of garden cress on 31 October attained significantly higher LAD at 30-60 days and 60-90 days and chlorophyll content of leaves at 50% flowering over 15 and 30 November sowing. The increase in LAD with 31 October sowing over 30 November sowing was 39.2% at 30-60 days and 43.2% at 60-90 days while the increase in chlorophyll content was 13.6%. Row spacing of 30 cm recorded significantly higher LAD over 40 cm representing an increase of 59.3 and 49.5% at 30-60 days and 60-90 days stages, respectively. Chlorophyll content was found unaffected by different spacings. Nitrogen application increased LAD as well as chlorophyll content. In LAD, the increase was significant with each increment of 20 kg N/ha up to the highest level of N (60 kg N/ha). However, chlorophyll content significantly increased when 40 or 60 kg N/ha was applied.

Yield attributes and yield

The 31 October sown crop of garden cress produced significantly higher number of seeds per plant over late sowings (15 and 30 November) representing an increase

Table 1. Effect of date of sowings, spacings and nitrogen levels on dry matter accumulation, LAD and chlorophyll content (Pooled mean of two years)

Treatment	Dry matter accumulation (g/m row length)				Leaf area duration (days)		Chlorophyll content (mg/g)
	30 DAS	60 DAS	90 DAS	At harvest	30-60 days	60-90 days	
Dates of sowing							
31 October	2.37	79.70	227.75	296.75	36.03	125.08	1.59
15 November	2.20	65.58	185.75	248.78	31.64	105.95	1.46
30 November	2.05	49.42	174.88	236.21	25.88	87.34	1.40
SEm±	0.03	0.75	3.35	2.59	0.53	1.79	0.02
CD (P=0.05)	0.09	2.22	9.90	7.64	1.55	5.28	0.05
Row spacing(cm)							
30	2.20	61.21	186.74	250.05	38.31	127.17	1.47
40	2.23	68.59	205.51	271.11	24.05	85.08	1.50
SEm±	0.02	0.61	2.74	2.11	0.43	1.46	0.01
CD (P=0.05)	NS	1.81	8.08	6.24	1.27	4.31	NS
N levels (kg/ ha)							
0	2.20	56.20	177.30	210.18	26.01	85.05	1.42
20	2.21	64.10	193.70	244.40	30.51	103.13	1.45
40	2.22	68.20	203.00	284.10	33.19	115.13	1.53
60	2.23	71.10	210.50	303.64	35.02	121.20	1.52
SEm±	0.03	0.54	2.49	2.72	0.51	1.51	0.02
CD (P=0.05)	NS	1.53	7.01	7.67	1.43	4.26	0.05

of 11.0 and 24.3%, respectively. Row spacing of 40 cm resulted in significantly higher number of seeds per plant as compared to 30 cm registering a significant increase of 14.3% (Table 1). Similar results in garden cress were also reported at Jodhpur (RAU, 2005). Application of nitrogen brought about a significant improvement on number of seeds per plant of garden cress wherein application of 60 kg N /ha proved significantly superior to preceding levels and registered an increase of 16.7, 7.3 and 3.0%, respectively, over control, 20 and 40 kg N/ ha.

Table 2. Interactive effect of date of sowing and row spacing on seeds/ plant

Treatment	30 cm	40 cm
31 October	2432	3035
15 November	2043	2536
30 November	1543	1886
SEm±	48	
CD (P=0.05)	141	

The interactive effect of dates of sowing and row spacing was found significant on seeds/plant of garden cress. The crop sown on 31 October at 40 cm row spacing recorded maximum seeds per plant and proved significantly superior to rest of the combinations of sowing date and row spacing, registering an increase of 48.6 and 96.7% over 30 cm row spacing with 15 and 30 November sown crop (Table 2).

Garden cress sown on 31 October gave significantly higher seed, stover and biological yields over late sowings (15 and 30 November). The 31 October sown crop recorded seed, stover and biological yields of 1.78, 5.22 and 7.00 t/ha, respectively. These yields indicated a significant increase of 19.6, 15.8 and 16.8 % higher over 15 November sowing and 51.4, 40.6 and 39.6% over 30 November sowing, respectively. The difference in yield of garden cress due to different sowing dates was also reported at several locations (RAU, 2005). Wider spacing (40 cm) gave significantly higher seed (11.4%), stover (7.1%) and biological yield (9.8%) over 30 cm row spacing. Nitrogen application to garden cress significantly increased the seed, stover and biological yields and the increase was significant due to each increment of 20 kg N/ ha up to the highest level (60 kg N/ha). These results also corroborated with those of Tiwari and Kulmi (2006) in garden cress.

Data (Table 3) indicated that 31 October sown crop gave significantly higher harvest index (25.3%) representing a mean increase of 7.9% over 30 November. Different row spacings could not bring any significant effect on harvest index. Data revealed that there was a progressive increase in harvest index with increasing nitrogen level up to 40 kg/ ha. Application of 60 kg N/ha recorded significant increase of 11.7% in harvest index over control (22.77%). However, application of 60 kg N/ ha was at par with 40 kg N/ ha with respect to harvest index.

Concentration and uptake of nutrients

Concentration of N, P and K in grain or stover was the highest with 30 November sown crop, significantly more than that obtained with 31 October and 15 November sown crop. This was mainly due to lower grain and stover yields obtained with late sown crop. N, P and K concentration in grain or stover of garden cress are not significantly influenced by row spacing. Nitrogen application increased N, P and K concentration in grain and stover of garden cress significantly, the increase was significant with each successive increment of 20 kg N/ha. The highest values for N, P and K concentration in grain or stover of garden cress were recorded with 60 kg N/ha.

N, P and K uptake by garden cress was the highest with 31 October sowing as compared to later dates of sowing. Row spacing had no significant effect on N,P and K

Table 3. Effect of dates of sowing, spacing and nitrogen levels on seeds/plant, yield, harvest index and B:C ratioof garden cress (Pooled mean of two years)

Treatment	Seeds/ plant	Seed yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	B:C ratio
Dates of sowing						
31 October,	2,754	1.78	5.22	7.00	25.30	2.07
15 November	2,290	1.49	4.50	5.99	24.65	1.56
30 November	1,714	1.18	3.84	5.02	23.45	1.03
SEm±	34	0.021	0.064	0.076	0.30	0.02
CD (P=0.05)	100	0.062	0.188	0.225	0.88	0.06
Row spacing (cm)						
30	2,006	1.40	4.33	5.73	24.22	1.42
40	2,486	1.56	4.71	6.27	24.71	1.69
SEm±	28	0.017	0.052	0.062	0.24	0.02
CD (P=0.05)	81	0.051	0.153	0.184	NS	0.05
N levels (kg/ha)						
0	2,048	1.10	3.71	4.81	22.77	0.94
20	2,227	1.42	4.40	5.82	24.28	1.48
40	2,320	1.64	4.80	6.44	25.38	1.82
60	2,390	1.77	5.16	6.93	25.42	1.98
SEm±	32	0.019	0.056	0.063	0.30	0.02
CD (P=0.05)	89	0.052	0.157	0.177	0.85	0.06

Table 4. Effect of dates of sowing, spacings and nitrogen levels on nutrient content and uptake of garden cress (Pooled mean of two years)

Treatment	N content (%)		Total N uptake (kg/ha)	P content (%)		Total P uptake (kg/ha)	K content (%)		Total K uptake (kg/ha)
	Seed	Stover		Seed	Stover		Seed	Stover	
Dates of sowing									
31 October	2.44	0.74	82.9	0.52	0.23	21.6	0.57	1.18	71.7
15 November	2.70	0.78	76.2	0.56	0.24	19.3	0.61	1.15	61.1
30 November	2.88	0.89	68.5	0.60	0.25	16.9	0.65	1.18	53.1
SEm±	0.028	0.006	1.38	0.005	0.001	0.29	0.004	0.005	0.87
CD (P=0.05)	0.082	0.017	4.1	0.02	0.004	0.9	0.013	0.015	2.6
Row spacing(cm)									
30	2.67	0.80	72.0	0.55	0.24	18.2	0.61	1.16	59.1
40	2.68	0.81	79.8	0.57	0.25	20.4	0.61	1.17	64.8
SEm±	0.023	0.005	1.1	0.004	0.001	0.24	0.004	0.004	0.7
CD (P=0.05)	NS	NS	3.3	NS	NS	0.7	NS	NS	2.11
N levels (kg/ ha)									
0	2.48	0.74	54.2	0.53	0.23	14.3	0.57	1.12	47.9
20	2.62	0.78	71.0	0.54	0.24	18.0	0.60	1.16	59.3
40	2.74	0.83	84.0	0.57	0.25	21.2	0.62	1.18	66.9
60	2.86	0.87	94.4	0.59	0.26	23.6	0.64	1.21	73.6
SEm±	0.024	0.005	1.03	0.006	0.001	0.29	0.004	0.005	0.84
CD (P=0.05)	0.066	0.015	2.9	0.02	0.004	0.8	0.012	0.013	2.4

uptake by garden cress. Nitrogen application resulted in a significant increase in N, P and K uptake by garden cress; each increment of 20 kg N/ha increased it significantly and the highest values were recorded up to 60 N/ha. This was due to increase in grain and stover yield as well as due to an increase in N, P and K concentration due to N fertilization.

Economics

The 31 October sown crop recorded significantly higher B:C ratio over 15 and 30 November sown crop (Table 3). The B:C ratio significantly decreased with delay in sowing time. This might be due to increased seed yield under early sown crop with same cost of cultivation for all three sowing dates. Sowing of garden cress at 40 cm row spacing (1.69) gave higher B:C ratio as compared to 30 cm row spacing. Application of increasing nitrogen levels significantly increased the B:C ratio wherein 60 kg/ha recorded maximum and significantly higher B:C ratio (1.98).

Based on the study, it is concluded that for the highest productivity and B:C ratio, garden cress should be sown in the last week of October at a spacing of 40 cm and 60 kg N/ha.

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