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EFFECT OF DIFFERENT ROW SPACING AND NUTRIENT MANAGEMENT LEVELS ON NUTRIENT CONTENT AND UPTAKE OF GARDEN CRESS CROP (*LEPIDIUM SATIVUM* L.)

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SUMMARY

The investigation entitled "Response of Garden cress [*Lepidium sativum* (L.)] to different row spacing and sources of nutrients" was conducted at the Medicinal, Aromatic and Potential Crop Section (MAP) Research Area of the Department of Genetics & Plant Breeding at CCS Haryana Agricultural University in Hisar, India, during the *rabi* seasons of 2022-23 and 2023-24. The experiment was laid out in split plot design with three replications, comprising of three row spacing levels viz. 40cm x 10cm (S_1), 30cm x 10cm (S_2) and 20cm x 10cm (S_3) in main plots and seven nutrient management levels viz. control *i.e.* no fertilizer (N_1), NPK @ 80:40:40 kg ha^{-1} (100%)(N_2), 50% N through inorganic fertilizer + 50% N through FYM (N_3), 50% N through inorganic fertilizer + 50% N through Vermicompost (N_4), 50% N through inorganic fertilizer + 25% N through FYM + 25% N through Vermicompost (N_5), 100% N through FYM (N_6) and 100% N through Vermicompost (N_7) in sub-plots. Based on two years pooled mean, it was concluded that the nitrogen, phosphorous and potassium (NPK) content in seed and stover of garden cress crop was not influenced by row spacing levels in both the years. Application of different nutrient management levels gave significant results in respect to nitrogen and potassium content in both seed and straw, but the results were non-significant in case of phosphorous content in stover. Different nutrient management levels also significantly affect nutrient uptake in seed as well as in straw. Maximum uptake was observed with the treatment N_5 (application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through Vermicompost) followed by N_2 (NPK @ 80:40:40 kg ha^{-1}). The NPK uptake was more in 2023-24 than 2022-23 in both seed as well as in stover. The uptake of NPK in seed and stover was found significantly highest with spacing of 30 cm x10 cm. The data on total uptake of NPK followed the same trend as observed in their uptake in seed and stover.

Key words: Garden cress, row spacing, nutrient management, NPK content and uptake

Garden cress (*Lepidium sativum*) *also known as* Chandershur is an annual, fast-growing, edible herbaceous plant. It belongs to the Brassicaceae family and shares many characteristics with mustard and watercress (Angel and Devi, 2015). Garden cress seeds are known by various names in different regions: cress, garden cress and pepper cress (English); lepidio (Spain); berro de sierra (Argentina); escobilla (Costa Rica); masturco, herba do esforzo (Portuguese and Galician); Chandrashoor, Chandrashur (India); Halim (Bengali and Urdu); Holan (Punjabi) ;Alian (Kashmiri); Aseliyo (Gujarati); Chansur (Hindi); Kapila (Kannada); Asali (Malayalam); Haliv (Marathi); Allivirai (Tamil) and Aadalu (Telugu) (Abu-Rumman, 2018). The genus *Lepidium* L. comprises about 232 species distributed worldwide (Warwick *et al.*, 2019). Garden cress seeds are native to Egypt and Southwest Asia and are widely cultivated in North America, India, and parts of Europe, including Britain, France, Italy, and Germany. This versatile plant has been utilized in Asia since the Vedic era due to its significant therapeutic and medicinal properties. In alternative medicines, all parts of the garden cress plant, including its seeds, are commonly used. Garden cress seeds are small, oval-shaped, and pointed with a triangular end. They are smooth in texture and typically measure about 3-4 mm long and 1-2 mm wide and are reddish-brown colour (Doke and Guha, 2014). It is extensively cultivated for various purposes such as cooking, traditional medicine and as an oilseed crop worldwide. Several studies have claimed the medicinal properties of garden cress seeds like diuretic, tonic, and chemo-protective effects and their ability to alleviate hiccups, dysentery, diarrhoea, and skin diseases (Alkahtani *et al*., 2020; Al-Sheddi *et al*., 2016, Desai *et al*., 2017; Ibrahim *et al*., 2020). In ancient times, these seeds were added to the diets of lactating women to induce milk secretion (Jain and Grover, 2020). According to Paranjape and Mehta (2006) its seeds are good tonic when given for feeding to the lactating animals, mainly after calving to meet the strain and drain of calving for first two weeks along with bajra grain, wheat brawn, methi, ginger, kalijiri, jiggery and oil. Chandershur could be utilized as animal feed/fodder to increase the milk production in lactating animals. Fertilization is the important input added externally for enhancing production of agricultural crops. When it is not applied sufficiently it may cause significant reduction in yield and quality. Planting geometry is also a necessary non- monetary agronomic practice which affects the yield of garden cress. Under changing climate scenario garden cress has great medicinal importance which make its cultivation most important (Choudhary *et al.,* 2022).

MATERIALS AND METHODS

The field experiment was conducted at the Medicinal, Aromatic, and Potential Crop Section (MAP) Research Area of the Department of Genetics & Plant Breeding at Chaudhary Charan Singh Haryana Agricultural University in Hisar, India, during the *rabi* seasons of 2022-23 and 2023-24. Geographically, the experimental site is situated at 29°10' N latitude and 75°46' E longitude, at an altitude of 215.2 meters above mean sea level. The region experiences a sub-tropical, semi-arid climate with hot, dry summers with temperatures reaching up to 48°C, and cold winters with temperatures dropping to 2-3°C. The rainfall is unevenly distributed throughout the year in this region, where almost 80% of the rainfall occurs during the monsoon season from July to September. The experimental field was laid out in a split-plot design with twenty one treatment combinations replicated thrice; three row spacing levels viz. 40cm x 10cm (S_1), 30cm x 10cm (S_2) and 20cm x 10cm (S_3) in main plots and seven nutrient management levels viz. control *i.e.* no fertilizer (N_1), NPK @ 80:40:40 kg ha^{-1} (100%)(N_2), 50% N through inorganic fertilizer + 50% N through FYM (N_3), 50% N through inorganic fertilizer + 50% N through vermicompost (N_4), 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5), 100% N through FYM (N_6) and 100% N through vermicompost (N_7) in sub-plots. Garden cress variety HLS-4 was sown in rows according to the treatments. The seed rate was kept at 6.0 kg ha^{-1} and seeds were sown at a depth of approximately 2 cm. Fertilizer was applied below the seed at sowing according to the treatment specifications. In the 100% treatment (N_2) N, P, and K were provided in the form of urea, di-ammonium phosphate (DAP, and muriate of potash (MOP), respectively. Organic nutrients were applied through farmyard manure (FYM) and vermicompost as pre treatments. The chemical composition of farmyard manure, vermicompost used in the experiment is shown in Table 1.

TABLE 1
Chemical composition of farmyard manure, vermicompost used in the experiment

Nutrient content	FYM		Vermicompost	
	2022-23	2023-24	2022-23	2023-24
Total N (%)	0.49	0.50	1.75	1.72
Available P (%)	0.19	0.23	0.50	0.47
Available K (%)	0.49	0.51	1.36	1.39

For determination of nutrient content (NPK) in seed and straw samples, individual samples were dried in an oven at 60 to 70°C until a constant weight was achieved. The samples were then ground into a fine powder using a stainless-steel grinder equipped with 60 mesh sieves. For the analysis, 0.2 g of dried seed samples and 0.5 g of straw samples were digested with 10 ml of diacid mixture of H_2SO_4 and $HClO_4$ in a 9:1 ratio on a hot plate until a clear colourless solution (3-4 ml) was obtained. This solution was transferred to a 50 ml conical flask and distilled water was added to bring the volume up to the mark. The solution was then filtered through Whatman filter paper No. 42 and stored in a plastic bottle for further analysis. Nessler's reagent method (Lindner, 1944) was used to determine the nitrogen content in straw and seed, using 0.2 ml of aliquot. The vanado-molybdate phosphoric yellow colour method (Jackson, 1973) was used to measure phosphorus in straw and seed samples, using 5 ml of aliquot. The flame photometer method (Richards, 1954) was used to determine the potassium content in straw and seed samples.

The uptake of N, P, and K in grain and straw was calculated in kg/ha using the following formulas:

$$\text{Nutrient uptake by seed (kg/ha)} = \frac{\text{Nutrient content in seed (\%)} \times \text{Seed yield (kg/ha)}}{100}$$

$$\text{Nutrient uptake by straw (kg/ha)} = \frac{\text{Nutrient content in straw (\%)} \times \text{Straw yield (kg/ha)}}{100}$$

RESULTS AND DISCUSSION

The experimental results related to nutrient content and uptake by garden cress seed and straw after statistical interpretation are presented in Table 2, 3 and 4.

NPK content and uptake by seed and straw

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

Perusal of data in Table 2 indicated that N content of both seed and straw did not differ significantly by row spacing levels. However, different nutrient management treatment levels varied significantly with respect to N content in seed as well as in straw. Based on pooled data of two years, application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5) was recorded highest (3.75%) nitrogen content in seed, which was statistically at par with N_2 (NPK @ 80:40:40 kg/ha). Nitrogen content in straw followed the same trend, N_5 recorded the highest nitrogen content (0.94%) in stover, which was at par with N_2 (NPK @ 80:40:40 kg/ha) and N_4 (50% N through inorganic fertilizer + 50% N through vermicompost). Nitrogen uptake in garden cress both differ significantly seed and straw by different row spacing and nutrient management levels during both the years of study. An appraisal of the data clearly revealed that significantly higher N uptake (56.45 and 46.01 kg/ha) by seed and straw respectively was found under S_2 (30 cm x 10 cm). N uptake in seed and straw was maximum (67.05 and 53.52 kg/ha) with the application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5). In case N uptake in straw, application of NPK @ 80:40:40 kg/ha was found to be at par with N_5.

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

Phosphorous content in seed and straw during both the year of experimentation (Table 3) was not varied significantly by different row spacing during both the years of study. However, P content of both seed and straw was numerically found higher in S_2 (30 cm x 10 cm) followed by S_1 (40 cm x 10 cm) and S_3 (20 cm x 10 cm). Based on pooled data of two

TABLE 2

Effect of different row spacing and nutrient management levels on N content and uptake of garden cress

Treatments	N- content (%)						N- uptake (kg/ha)					
	Seed			Stover			Seed			Stover		
	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean
Row spacing levels												
S_1	3.37	3.43	3.4	0.86	0.85	0.86	47.05	50.17	48.61	39.43	41.33	40.32
S_2	3.47	3.49	3.48	0.87	0.87	0.87	54.55	56.98	55.77	44.67	46.77	45.53
S_3	3.39	3.4	3.4	0.85	0.85	0.85	44.65	46.94	45.79	42.85	45.13	44.02
SEm±	0.04	0.03	0.04	0.01	0.01	0.01	0.85	1.09	0.97	0.30	0.42	0.36
CD at 5%	NS	NS	NS	NS	NS	NS	3.44	4.38	3.91	1.22	1.71	1.47
Nutrient management levels												
N_1	2.99	3.02	3.01	0.76	0.75	0.76	31.53	33.01	32.27	31.61	33.78	32.58
N_2	3.62	3.69	3.66	0.92	0.91	0.92	62.14	65.79	63.97	50.65	54.11	52.02
N_3	3.46	3.49	3.48	0.87	0.89	0.88	51.08	53.80	52.44	43.94	45.51	45.27
N_4	3.6	3.62	3.61	0.91	0.88	0.9	53.34	56.07	54.70	46.52	46.43	46.60
N_5	3.73	3.75	3.75	0.94	0.93	0.94	65.3	68.53	66.91	52.05	55.09	53.53
N_6	3.15	3.16	3.16	0.79	0.8	0.8	39.43	41.59	40.51	35.57	37.12	36.34
N_7	3.31	3.35	3.33	0.82	0.84	0.83	41.97	44.67	43.32	37.53	38.82	38.60
SEm±	0.04	0.04	0.04	0.01	0.01	0.01	0.97	1.08	1.03	0.61	0.87	0.74
CD at 5%	0.12	0.11	0.12	0.03	0.05	0.04	2.80	3.12	2.96	1.75	2.94	2.35

Where, S_1= 40x10 (cm); S_2= 30x10 (cm); S_3= 20x10 (cm); N_1= Control (No fertilizer); N_2= NPK @ 80:40:40 kg ha^{-1}; N_3= 50% N through inorganic fertilizer + 50% N through FYM; N_4= 50% N through inorganic fertilizer + 50% N through Vermicompost; N_5= 50% N through inorganic fertilizer + 25% N through FYM + 25% N through Vermicompost; N_6= 100% N through FYM and N_7= 100% N through Vermicompost.

TABLE 3

Effect of different row spacing and nutrient management levels on P content and uptake of garden cress

Treatments	P- content (%)						P- uptake (kg/ha)					
	Seed			Stover			Seed			Stover		
	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean
Row spacing levels												
S_1	0.60	0.60	0.60	0.20	0.20	0.20	8.36	8.80	8.58	9.22	9.70	9.46
S_2	0.62	0.62	0.62	0.21	0.21	0.21	9.70	10.11	9.90	10.58	10.98	10.78
S_3	0.58	0.59	0.58	0.19	0.20	0.19	7.67	8.08	7.87	9.78	10.42	10.10
SEm±	0.008	0.007	0.008	0.003	0.002	0.003	0.19	0.14	0.16	0.14	0.13	0.13
CD at 5%	NS	NS	NS	NS	NS	NS	0.77	0.56	0.66	0.56	0.52	0.54
Nutrient management levels												
N_1	0.51	0.51	0.51	0.17	0.17	0.17	5.38	5.58	5.48	7.07	7.56	7.31
N_2	0.66	0.66	0.66	0.22	0.22	0.22	11.33	11.75	11.54	12.11	12.79	12.45
N_3	0.62	0.62	0.62	0.20	0.20	0.20	9.08	9.50	9.29	10.35	10.63	10.49
N_4	0.63	0.64	0.64	0.21	0.21	0.21	9.41	9.87	9.64	10.84	11.25	11.04
N_5	0.65	0.66	0.66	0.22	0.22	0.22	11.45	12.06	11.76	12.18	13.01	12.60
N_6	0.55	0.55	0.55	0.19	0.19	0.19	6.93	7.20	7.07	8.33	8.86	8.60
N_7	0.57	0.58	0.58	0.19	0.19	0.19	7.28	7.71	7.49	8.74	9.12	8.93
SEm±	0.009	0.008	0.009	0.004	0.003	0.004	0.17	0.19	0.18	0.19	0.21	0.20
CD at 5%	0.026	0.025	0.026	NS	NS	NS	0.50	0.54	0.52	0.55	0.59	0.57

TABLE 4

Effect of different row spacing and nutrient management levels on K content and uptake of garden cress

Treatments	K- content (%)						K- uptake (kg/ha)					
	Seed			Stover			Seed			Stover		
	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean
Row spacing levels												
S_1	0.59	0.60	0.60	1.41	1.41	1.42	8.35	8.78	8.56	64.88	68.56	67.176
S_2	0.60	0.60	0.60	1.44	1.45	1.49	9.46	9.80	9.63	74.25	77.26	76.272
S_3	0.60	0.61	0.61	1.41	1.41	1.41	7.94	8.38	8.16	71.19	75.00	73.39
SEm±	0.008	0.008	0.008	0.013	0.025	0.019	0.11	0.17	0.14	0.88	1.82	1.351
CD at 5%	NS	NS	NS	NS	NS	NS	0.454	0.679	0.567	3.544	NS	-
Nutrient management levels												
N_1	0.52	0.53	0.53	1.31	1.32	1.32	5.57	5.76	5.66	54.61	58.90	56.76
N_2	0.64	0.64	0.64	1.53	1.53	1.53	11.02	11.43	11.23	84.45	89.87	87.16
N_3	0.61	0.61	0.61	1.42	1.43	1.43	9.05	9.45	9.25	72.18	74.85	73.52
N_4	0.61	0.61	0.61	1.42	1.42	1.42	9.04	9.46	9.25	72.95	75.34	74.14
N_5	0.65	0.65	0.65	1.54	1.56	1.55	11.48	11.91	11.70	85.27	92.05	88.66
N_6	0.57	0.58	0.58	1.36	1.36	1.36	7.23	7.59	7.41	61.28	62.90	62.09
N_7	0.58	0.59	0.59	1.36	1.36	1.37	7.41	7.88	7.64	62.56	64.44	63.50
SEm±	0.011	0.009	0.010	0.021	0.031	0.026	0.17	0.21	0.19	1.21	1.76	1.48
CD at 5%	0.031	0.027	0.029	0.059	0.088	0.074	0.47	0.61	0.54	3.46	5.06	4.26

years, among various nitrogen management levels, phosphorous content in seed was significantly maximum (0.660%) with the application of NPK @ 80:40:40 kg ha^{-1} followed by application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5) treatment (0.657%) and N_4 treatment (0.636%). However, during both the years, phosphorous content in straw was not found significant. Significantly higher P uptake (10.027 and 10.885 kg/ha) by seed and straw respectively was found under S_2 (30 cm x 10 cm). Among nitrogen management levels, P uptake in seed and straw was maximum (11.760 and 12.597 kg/ha) with the application of 50% N through inorganic

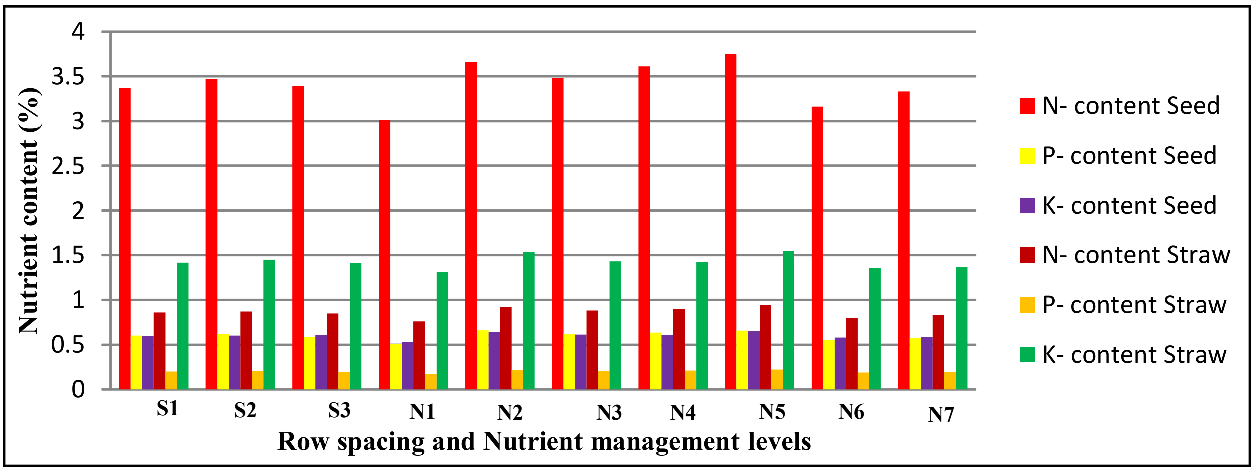

Fig. 1. Effect of different row spacing and nutrient management levels on NPK content and uptake of garden cress.

fertilizer + 25% N through FYM + 25% N through vermicompost (N_5), which was found to be at par with application of NPK @ 80:40:40 kg/ha (N_2).

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

Row spacing did not affect potassium content in both seed and straw but significant affect was noticed under nutrient management levels. Potassium content in seed and straw was significantly maximum (0.654% and 1.548%) with the application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5) treatment followed by (0.642% and 1.533%) with application of NPK @ 80:40:40 kg/ha. An appraisal of the pooled data of two years clearly revealed that significantly higher K uptake (9.726 kg/ha) by seed was found under S_2 (30 cm x 10 cm). K uptake in seed and straw was maximum (11.694 and 88.635 kg/ha) with the application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost (N_5), which was found to be at par with application of NPK @ 80:40:40 kg/ha (N_2).

Improvement in nutritional status of seed and straw due to application of inorganic fertilizers along with organic fertilizers could be due to the readily available nutrient in soil environment as well as their extraction and translocation into the plant system. It is generally believed that in plant system extracted nutrients are used for maintaining their critical concentration, which can be used for growth and development of plant structure. The greater uptake of plant nutrients may be due to better translocation of photosynthates to different plant parts resulted into higher nutrient content in seed and straw. Similar results were reported by Yadav *et al.* (2013); Praneeth *et al.,* 2018 in garden cress crop; Charak et al. (2006) in toria crop; Meena *et al*. (2022) in mustard and Tiwari *et al.* (2012) in kalmegh crop.

CONCLUSION

The results of the field experiment conducted during 2022–23 and 2023–24 may be concluded that nutrient content (NPK) of garden cress seed and straw was not varied significantly by different row spacing during both the years of study. However, numerically found higher in S_2 (30 cm x 10 cm) followed by S_1 (40 cm x 10 cm) and S_3 (20 cm x 10 cm). Application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost resulted into maximum NPK content and their uptake followed by application of NPK @ 80:40:40 kg/ha). Nutrient uptake in differ significantly seed and straw by different row spacing and nutrient management levels during both the years of study. Significantly higher NPK uptake by seed and straw was found when garden cress was sown with the spacing of 30 cm x 10 cm and application of 50% N through inorganic fertilizer + 25% N through FYM + 25% N through vermicompost.

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