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PHYSIOLOGICAL PARAMETERS AND QUALITY OF GARDEN CRESS (*LEPIDIUM SATIVUM* L.) AS INFLUENCED BY DATES OF SOWING AND FERTILIZER LEVELS

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Abstract

Garden cress (*Lepidium sativum* L.) is an upcoming medicinal plant, belonging to the family Cruciferae. A field experiment was conducted with the combination of 3 dates of sowing as main plot treatments and 5 levels of fertilizer as sub plot treatments in split plot design with three replications, under the Northern dry zone of Karnataka, India. During 75 DAS to harvest, significantly maximum AGR (0.28 g.day^{-1}) and CGR (9.39 gm^{-2} day^{-1}) were recorded when the crop was sown on 1st November (D_2). Application of 80:80:30 kg of NPK/ha (F_4) resulted in significantly maximum AGR (0.31 g day^{-1}), RGR (10.97 mg g day^{-1}) and CGR (10.17 g m^{-2} day^{-1}). But, the interaction effect for AGR, RGR and CGR were found to be non-significant. Significantly higher oil content (18.30%) was recorded in D_2F_2 combination and oil yield (842.89 kg/ha) was found in D_2F_4 combination, while the least oil content and oil yield (14.07% and 319.10 kg/ha, respectively) was noticed in D_1F_0 combination.

Key words : Garden cress (*Lepidium sativum* L.), dates of sowing, fertilizer levels, AGR, RGR, CGR and oil content.

Introduction

Medicinal plants constitute a major segment of the flora, which provides raw materials for use in the pharmaceuticals and drug industries. The indigenous systems of medicines were developed in India for centuries to make use of many medicinal herbs. India is a meadow of medicinal plants where most of the plant species are exploited for traditional system of medicine.

Garden cress (*Lepidium sativum* L.) is one such upcoming medicinal plant, belonging to the family Cruciferae, which has plenty of medicinal properties. It is commonly known as *garden cress* or *common cress* (English), *Chandrasur* (Hindi), *Adeli / Adityalu* (Telugu), *Alavibija* (Kannada), *Asalio* (Gujarathi).

Lepidium is believed to have originated primarily in the high land region of Ethiopia and Eritrea. The Europe and western Asia are regarded as secondary centers of origin (Stchenkova, 1932). Though seeds, leaves and roots are the economic parts, the crop is mainly cultivated for seeds in India (Gokavi *et al*., 2004).

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The seeds morphologically resemble some of the oil seeds, with the dicotyledonous endosperm accounting for 80 to 85 per cent of the seed matter, whereas, the seed coat and embryo account for 12 to 17 per cent and 2 to 3 per cent of seeds, respectively. The seed coat is brick red to cream coloured, the endosperm has yellow colour. The seeds contain alkaloids lepidin, glucotropaeolin, besides sinapin, sinapinic acid, mucilaginous matter (5%) and uric acid (0.108g per kg). Seeds also contain vitamin-C and vitamins of B group. The seeds yield yellowish brown semidrying oil which has peculiar disagreeable odour. Seeds also contain 5.69 per cent moisture, 23.5 per cent protein, 15.9 per cent fat, 5.7 per cent ash, phosphorus (1.65%), calcium (0.31%) and sulphur (0.9%). These seeds are good source to enhance the milk percentage in cattle as well as in nursing mothers. Fresh leaves and young seedlings are mainly used as spice and are rich source of glucosinolates (Gil and Macleod, 1980) and also used as salads. Roots are bitter, acrid and are useful in treatment of secondary syphilis.

Garden cress seeds are mainly used in Ayurveda, Unani and Siddha systems of medicine for asthma, cough

with expectoration, poultice for sprains, leprosy, skin disease, dysentery, diarrhoea, splenomegaly, dyspepsia, lumbago, leucorrhoea, scurvy and seminal weakness (Kirtikar and Basu, 1960). They are beneficial in promoting digestion and growth in children. Seed oil is externally used in rheumatism. The extracts of seed have hypotensive effect with transient respiratory stimulation. They are boiled with milk and are used to induce abortion (Chopra, 1986).

Presently, cultivation of the crop is mainly confined to North Indian states. However, due to increase in its usage, besides an assured remuneration, there is a need to expand the area under this valuable medicinal crop. Hence, there is a need to do research on location specific sowing season of the crop and its fertilizer requirement for obtaining the quality seed.

Materials and Methods

An investigation was carried out at the Department of Medicinal and Aromatic Plants, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot during October 2010 to February 2011. Geographically, Arabhavi is situated in northern dry tract of Karnataka state at $16^{O}15'$ North latitude and $74^{0}45'$ East longitude and at an altitude of 612 m above the mean sea level, with an average monthly rainfall of 40.86 mm during the crop duration. The soil of the experimental site was medium deep black. A field experiment was conducted with 3 dates of sowing (D_1- 15th October, D_2-1st November and D_3-15th November) as main plot treatments and 5 levels of fertilizer (F_0- control, F_1- 20:20:30 kg of NPK/ha, F_2- 40:40:30 kg of NPK/ha, F_3- 60:60:30 kg of NPK/ha, F_4- 80:80:30 kg of NPK/ha) as sub plot treatments in split plot design with three replications.

The experimental plot was ploughed thoroughly, levelled and the seeds were mixed with fine sand in 1:10 proportion before sowing to ensure their even distribution. The crop was sown as per the treatments in lines of 30 cm apart and at 5 cm depth. Seed rate was 4 kg per hectare and spacing followed was 30 × 10 cm. 10 tonnes of FYM per hectare was applied as a common dose for all the treatments. The plots were supplied with half the dose of nitrogen (in the form of urea) and full dose of phosphorus (in the form of single super phosphate) and potassium (in the form of muriate of potash) at the time of sowing as per the treatments. The remaining half dose of nitrogen was supplemented 30 days after sowing as top dressing and the light earthing up was done. Timely Weeding was done to keep the plot weed free and irrigation was given depending on soil moisture conditions.

Five plants were randomly selected by avoiding the border plants and were labelled for recording the observations at 25, 50, 75 days after sowing (DAS) and at harvest. Absolute Growth Rate (AGR), Relative Growth Rate (RGR), Cumulative Growth Rate (CGR) were calculated by using the following formulae.

$$AGR = \frac{(W_2 - W_1)}{(t_2 - t_1)}$$

$$RGR = \frac{(\log eW_2 - \log eW_1)}{(t_2 - t_1)}$$

$$CGR = \frac{(W_2 - W_1)}{(t_2 - t_1)} \times \frac{1}{A}$$

Where, W_1 = Dry weight of the plant at time t_1

W_2 = Dry weight of the plant at time t_2

A = Land area

The collected data was subjected to statistical analysis using the Fischer's method of analysis of variance technique as given by Panse and Sukhatme (1967). The crop was harvested at 95-100 days after sowing when the plants turned yellow in colour and the siliqua exhibited red colored seeds when split. The seeds were separated and cleaned. For estimation of oil content, 100 g of seeds were taken from each plot and were uniformly dried and analyzed using NMR spectroscopy and was expressed in percentage.

Results and Discussion

Data pertaining to physiological parameters as influenced by dates of sowing, fertilizer levels and their interaction is presented in table 1 and quality parameters in table 2 and fig. 1.

Physiological parameters

Absolute growth rate (AGR), Relative growth rate (RGR) and Cumulative growth rate (CGR) decreased with the advancement of crop age and were higher at the initial stages of the crop growth. During 75 DAS to harvest, significantly maximum AGR (0.28 g day^{-1}) and CGR (9.39 g m^{-2} day^{-1}) were recorded when the crop was sown on 1st November (D_2). This might be due to the congenial weather conditions which resulted in robust growth of the plants and higher dry matter accumulation in the crop sown on 1st November. RGR was found to be non-significant due to dates of sowing.

Application of 80:80:30 kg of NPK/ha (F_4) resulted significantly higher AGR (0.31 g day^{-1}), RGR (10.97 mg

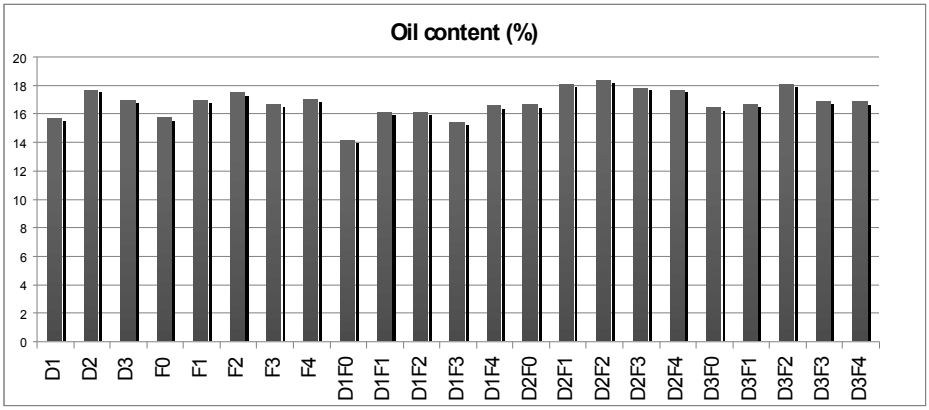

Fig. 1 : Oil content (%) in garden cress (*Lepidium sativum* L.) as influenced by dates of sowing and fertilizer levels.

Dates of sowing
D_1=15th October, **D_2**=1st November, **D_3**=15th November

Fertilizer levels
F_0= control, **F_1**= 20:20:30 NPK kg/ha, **F_2**= 40:40:30 NPK kg/ha, **F_3**=60:60:30 NPK kg/ha, **F_4**= 80:80:30 NPK kg/ha

Table 1 : Effect of dates of sowing and fertilizer levels on AGR, RGR and CGR in garden cress (*Lepidium sativum* L.).

Treatments	AGR at 75 DAS to harvest ($g\ day^{-1}$)				RGR at 75 DAS to harvest ($mg\ g\ day^{-1}$)				CGR at 75 DAS to harvest ($g\ m^{-2}\ day^{-1}$)			
	Sowing dates											
Fertilizer Levels (F)	D_1	D_2	D_3	Mean	D_1	D_2	D_3	Mean	D_1	D_2	D_3	Mean
F_0	0.13	0.21	0.17	0.17	8.41	11.30	9.60	9.77	4.44	7.11	5.78	5.78
F_1	0.16	0.25	0.22	0.21	9.42	12.04	10.97	10.81	5.33	5.44	7.41	7.06
F_2	0.17	0.28	0.24	0.23	8.47	11.54	10.23	10.08	5.78	9.33	8.00	7.70
F_3	0.19	0.31	0.27	0.26	9.10	11.58	10.79	10.49	6.37	10.37	9.04	8.59
F_4	0.26	0.35	0.31	0.31	10.19	11.94	10.79	10.97	8.59	11.70	10.22	10.17
Mean	0.18	0.28	0.24		9.12	11.68	10.42		6.10	9.39	8.09	

To compare the means of	S.Em±	C.D. @ 5 %	S.Em±	C.D. @ 5 %	S. Em±	C.D. @ 5 %
Dates of Sowing (D)	0.014	0.05	0.88	NS	0.46	1.80
Fertilizer levels (F)	0.007	0.02	0.26	0.75	0.24	0.69
F at same D	0.012	NS	0.44	NS	0.41	NS
D at same or different F	0.018	NS	0.96	NS	0.59	NS

Dates of sowing : D_1=15th October, D_2=1st November, D_3=15th November.
Fertilizer levels : F_0= control, F_1= 20:20:30 NPK kg/ha, F_2= 40:40:30 NPK kg/ha, F_3= 60:60:30 NPK kg/ha, F_4= 80:80:30 NPK kg/ha.

$g\ day^{-1}$) and CGR (10.17 $g\ m^{-2}\ day^{-1}$). This might be due to better vegetative growth in terms of highest plant height, number of branches, leaves and total dry matter accumulation in the plants supplied with higher level of fertilizers. These results are in agreement with Santosh *et al*. (2010) in garden cress.

But, the interaction effect for AGR, RGR and CGR were found to be non-significant (table 2). At 75 DAS to harvest, maximum absolute growth rate (0.35 $g\ day^{-1}$), relative growth rate (11.94 $mg\ g\ day^{-1}$) and cumulative growth rate (11.70 $g\ m^{-2}\ day^{-1}$) were recorded with the crop sown on 1st November and supplied with 80:80:30 kg of NPK/ha (D_2F_4 combination).

Quality parameters

Significantly maximum oil content and oil yield (17.67% and 664.26 kg/ha, respectively) was recorded in the plants sown on 1st November (D_2), while it was minimum (15.61% and 453.01 kg/ha, respectively) in 15th October (D_1) sown plants. The reasons for higher oil yield in case of 1st November sown plants might be

Table 2 : Effect of dates of sowing and fertilizer levels on oil content and oil yield in garden cress (*Lepidium sativum* L.).

Treatments	Oil content (%)				Oil yield (kg/ha)			
	Sowing dates							
Fertilizer levels (F)	D_1	D_2	D_3	Mean	D_1	D_2	D_3	Mean
F_0	14.07	16.57	16.37	15.67	319.10	461.22	404.01	394.78
F_1	16.03	18.03	16.63	16.90	407.80	561.72	477.76	482.42
F_2	16.03	18.30	18.03	17.46	439.35	625.25	567.40	543.99
F_3	15.37	17.77	16.83	16.66	472.81	830.21	634.32	645.78
F_4	16.53	17.67	16.77	16.99	626.00	842.89	796.94	755.28
Mean	15.61	17.67	16.93		453.01	664.26	576.08	

To compare the means of	S.Em ±	C.D. @ 5%	S.Em ±	C.D. @ 5%
Dates of Sowing (D)	0.16	0.61	9.21	36.15
Fertilizer levels (F)	0.12	0.35	6.72	19.62
F at same D	0.21	0.60	11.64	33.98
D at same or different F	0.24	0.70	13.90	40.57

Dates of sowing : D_1=15th October, D_2=1st November, D_3=15th November
Fertilizer levels : F_0= control, F_1= 20:20:30 NPK kg/ha, F_2= 40:40:30 NPK kg/ha, F_3= 60:60:30 NPK kg/ha, F_4= 80:80:30 NPK kg/ha.

attributed to higher seed yield due to increased yield attributes and higher oil content. The influence of sowing dates on oil yield is in concurrence with the findings of Santosh *et al*. (2010) in garden cress, Bhati and Shaktawat (1994) in coriander and Randhawa *et al*. (1981) in fennel.

The oil content and oil yield were significantly influenced by fertilizer levels. Higher oil content (17.46%) was produced with the application of fertilizer at 40:40:30 kg of NPK per hectare (F_2) and oil yield (755.28 kg/ha) was produced with the application of fertilizer at 80:80:30 kg of NPK per hectare (F_4), while minimum (15.67% and 394.78 kg/ha, respectively) was produced in control (F_0) where no fertilizer was applied. The increased oil content at lower fertilizer level might be due to reduced growth, which resulted in the diversion of photosynthates for synthesis of oil. Fertilizers play a positive role in metabolism of plants, which increased seed yield with increase in fertilizers dose and hence the higher oil yield was noticed at higher doses of fertilizer. Similar results were earlier noticed by Santosh *et al.* (2010) in garden cress, Patel *et al.* (2003) in fennel, Mandal and Sinha (2002) in Indian mustard, Chanda *et al.* (2001) in mint and Krishnamoorthy *et al*. (2000) in ajowan.

Interaction of dates of sowing and fertilizer level exhibited significant influence on oil content and oil yield. Higher oil content (18.30%) was recorded in D_2F_2 combination and oil yield (842.89 kg/ha) was found in D_2F_4 combination, while the least oil content and oil yield (14.07% and 319.10 kg/ha, respectively) was noticed in D_1F_0 combination. The higher essential oil yield per hectare in D_2F_4 combination was mainly attributed due to positive effect of sowing dates and fertilizer levels on oil content and oil yield and the same beneficial effect has been reflected in the combination also.

From the present study, it can be concluded that the garden cress sown on 1st November and supplemented with 80:80:30 kg of NPK per hectare (D_2F_4) is beneficial for attaining the maximum AGR, RGR, CGR and quality seed with higher oil yield, under the northern dry zone of Karnataka.

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