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Effect of Different Fertility Levels and Row Spacing on Yield Attributes and Economics of Kalmegh (*Andrographis Paniculata*)

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Abstract

A field experiment was conducted during *kharif* season 2018-19 at Soil Conservation and Water Management farm of C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in factorial randomized block design with 3 replications. Different fertilizer doses were given according to treatment i.e. F_1 (30:15), F_2(60:30), F_3 (90:45), crop was transplanted by hand in the field according to the treatment. Plant to plant spacing was maintained as 20 cm, and row to row spacing was set as 30, 40 and 50 cm randomly according to the treatments. Among the following treatments, the treatment with fertilizer dose 90 kg N + 45kg P_2O_5 ha^{-1} (F_3) in combination with 40 cm row spacing (S_2) recorded highest growth and was significantly superior over all other treatments. Yield attributing characters and economics of the treatment with F_3S_2 were recorded highest and significantly superior over other treatments.

***Keywords :** Fertility levels, spacing, yield attributes, economics, kalmegh.*

Introduction

Kalmegh (*Andrographis paniculata* Wall. Ex. Nees) belonging to family Acanthaceae is one of the nineteen species of the genus *Andrographis* which indigenous to india and has been in Indian system of medicine since time immemorial kalmegh is a bitter annual herb erect 50 cm to 1 m in height stem quadrangular much brached leaves opposite short petioled, racemes inflorescence, fruit capsule, linear, oblong or elliptic, seeds about 12 number sub quadrate brownish or creamy yellow. Traditionally, *Andrographis* has been used for liver complaints fever, acrid, cooling, laxative, vulnerary, antipyretic, antiperiodic, anti-inflammatory, expectorant, depurative, soporific, anthelmintic, digestive and useful in hyperdispsia, burning sensation, wounds, ulcers, chronic fever, malaria and intermittent fevers, inflammations, cough, bronchitis, skin diseases, leprosy, colic, flatulence, diarrhoea, and dysentery. Kalmegh is also a reputed Homoeopathic drug. In Bengal, household medicine known as “Alui” is prepared from fresh leaves and is given to children suffering from stomach complaints. Recent experimental finding indicated that Kalmegh is having anti-typhoid and antibiotic properties (1). Kalmegh mainly cultivated throughout plains of India from Uttar Pradesh to Assam, Madhya Pradesh, Tamil Nadu and Kerala. It can be cultivated on wide range of soils from loam to lateritic soils with moderate fertility. It can be cultivated on shady wastelands also. It required hot and humid climatic conditions with ample sunshine. Flowering is continues up to December unit temperature drops drastically in Northern plains.

Andrographolide is the chemical constituent of kalmegh contains all part of the plantsbut the leaves of kalmegh contain the highest amount. Kalmegh is a short duration crop and grown for medicinal purpose in *kharif*se ason and thus weed infestation is very high in this crop. The fresh and dried leaves of kalmegh and the juice extracted from the herb are official drugs in Indian pharmacopoeia. The whole herb is the source of several diterpenoids of which the bitter water-soluble lactone andrographolide is important and is distributed all over the plant body in different proportions. It is an active constituent in majority of Ayurvedic preparations and is official in the Ayurvedic Pharmacopoeia (2). The leaves contain the maximum (2.5%) andrographolide content while the stem contains a smaller amount (2.0%) of active principle. In addition the plant is an important source of the flavonoids, sesquiterpenes, and phenyl propanoides. The roots contain the flavonoids, rographin, panicotin, aplegenin-4, 7-dimethyl ether, mono-omethylwightin, hydroxyl-7,8, 2, 3-trimythoxy flavones and sitosterol. Phenyl propanoideugenol has also been recorded in the aerial part of the plant. The diterpenoid and sesquiterpenoid compounds occuring in *A. paniculata* have been referred to as paniculides and andrographolides. Besides the flavonoides, caffeic acid chlorogenic acid and dicaffeoyloquinic acids are also present in this plant. The expressed juice of the leaves of Kalmegh is prescribed with cardamom, cloves and

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cinnamon in the form of globules to infants for relief from bowel complaints, irregular stools and loss of appetite. The plant is considered to be highly efficacious against chronic malaria and often used as a substitute for Swertiachirata. The hot water extract of the whole plant is used for acute jaundice, where the powder is mixed with garlic and 2g of this mixture is given orally with buttermilk for four days and also as febrifuge and as an antidysentric agent. Due to huge gap between demand and supply, there is a need to enhance the production of Garden cress by developing package of practices, post-harvest management, processing, value addition and marketing of this crop. So there is an urgent need to develop and standardized the agronomical practices such as spacing, plant geometry, fertilizer requirement etc. for reaping good yield and to provide information to farmers for its cultivation. As a minor crop at last moment when sowing of main crops is over and sometimes broadcast the seeds in field with other *kharif* crops.

Materials and Methods

The experiment was laid out at Soil Conservation and Water Management farm which is situated just adjacent to main campus of university in the Gangetic alluvial plain zone of central Uttar Pradesh. It lies between 25^0 26' to 26^0 58' N latitude and 79^0 31' to 80^0 34' East longitude at an elevation of about 126.6 meters from mean sea level, average annual rainfall of about 834 mm, the most of which is received during monsoon season between last week of June to end of September with occasional showers in winter months. The soil of experimental field was a typical Gangetic alluvium falling under the textured class sandy loam. After field operation, soil sample were drawn randomly at 5 places in whole experimental area from 0-15 cm depth before sowing. Nine treatments of *Andrographis. paniculata*' were grown in randomized complete block design (RBD) with factorial concept in the field and observations were recorded for seven quantitative traits and Seed were used as planting material. Plant samples at harvest for chemical analysis were collected and shade dried for two days and then dried in a hot air oven at a temperature of 50 ^{0}C for 24 hours. The plant samples were ground into fine poNitrogen content in the plant sample on dry weight basis was estimated with a di-acid extract by Micro Kjeldahl method and expressed in per cent, and phosphorus with a triple acid extract by adopting Vanado-molybdate phosphoric yellow colour method and expressed in per cent. From the total dry matter production and estimated nitrogen, phosphorus and total uptake of respective nutrients were worked out using the following formula and was expressed in Kg ha^{-1}.

$$\text{Nutrient content (\%)} \quad \frac{\text{Total Dry matter production (kg / ha)}}{100}$$

Results and Discussion

Influence on Yield Attributes : The important attributes related to yield *viz*., fresh weight at harvest total dry weight at harvest were significantly affected by various treatment combinations except interaction of fertility and spacing levels. The fertility levels F_3 (90 kg N + 45kg P_2O_5 ha^{-1}) recorded maximum yield which was followed by F_2 (60 kg N + 30kg P_2O_5 ha^{-1}). These results are in close conformity to the findings of (3).

Between spacing,40 cm row spacing recorded the highest yield at par 30cm and 50cm. The crop sown at spacing 40 cm recorded the maximum fresh weight and total dry weight at harvest. There is a significant difference among all the treatments. The results are also in consonance with those reported by (4). This might be due to wider spacing, which provide more area, water, light and less nutrient competition among plants which helps to increase the yield. According to (4) as increasing the fertility levels resulted as significantly increased the fresh and dry weight of the plant. These results are in conformity with those reported by (5). The study revealed that the yield parameters were significantly influenced by the application of high dose of fertility, nitrogen being a main constituent of protein and nucleic acid, it mainly influences the cell division, cell elongation and thereby it could increase the growth of plant. The nitrogen also increased availability of nitrogen, the plant synthesizes protein and other enzymes, which results in increasing the cell number and cell size leading to better growth of the plant. Yield attributes like fresh weight at harvest (q ha^{-1}), dry weight at harvest (q ha^{-1}), played a vital role in increasing the productivity of kalmegh crop. The result are in accordance with the findings reported by (6, 7, 8).

Influence on Nutrient Uptake : Among the fertility levels F_3 (90 kg N + 45kg P_2O_5 ha^{-1}) recorded higher extraction of nitrogen in comparison to F_2 and F_1. While, among spacing S_2 (40 cm row spacing) showed significantly better performance over others. These results are in conformity with those reported by (9).

The data on phosphorus uptake revealed that fertility levels F_3 (90 kg N + 45kg P_2O_5 ha^{-1}) recorded higher uptake over F_2 and F_1 whereas, among spacing, 40 cm row spacingextract more amount of available phosphorus than S_1 and S_3 while, the interaction effect between spacing and fertility levels was found non-significant in terms of nitrogen and phosphorus uptake.

Table-1 : Effect of spacing and fertility levels on Fresh weight and Dry weight (q/ha) at 120 days after transplanting.

Treatments	Fresh wt. (120 DAT)	Dry wt. (120 DAT)
F_1S_1	146.35	49.95
F_1S_2	151.70	51.80
F_1S_3	130.40	39.25
F_2S_1	165.75	56.35
F_2S_2	175.35	59.75
F_2S_3	140.35	48.25
F_3S_1	173.50	58.40
F_3S_2	181.60	61.33
F_3S_3	156.15	62.75
SE(d)	11.01	3.79
CD (P=0.05)	N.S	N.S

Table-2 : Effect of spacing and fertility levels on Nitrogen and phosphorus uptake (Kg/ha) at 120 days after transplanting.

Treatments	N uptake (Kg/ha)	P uptake (Kg/ha)
F_1S1	37.35	12.42
F_1S_2	38.75	12.80
F_1S_3	29.75	10.20
F_2S_1	42.33	13.95
F_2S_2	45.15	14.85
F_2S_3	35.80	12.15
F_3S_1	43.90	14.65
F_3S_2	46.10	12.15
F_3S_3	39.20	13.25

Table-3 : Effect of spacing and fertility levels on Economics of Kalmegh.

Treat-ments	Cost of cultivation (Rs./ha) of cultivation (Rs//ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B.C. Ratio
F_1S_1	25306	174825	149519	6.9
F_1S_2	26106	181300	159194	6.9
F_1S_3	26481	137375	110894	5.1
F_2S_1	26475	197225	170750	7.4
F_2S_2	27425	204655	180230	7.5
F_2S_3	27741	168875	141134	6.1
F_3S_1	27739	204400	176661	7.3
F_3S_2	27375	209125	181750	7.6
F_3S_3	28875	209625	180750	7.2

Conclusions

The data obtained from observations of Yield attributes, Nutrient uptake and economics were processed, tabulated and subjected to statistical analysis by standards methods to draw valid conclusion from the study. The research results pertaining to each aspect have been presented and found that at all stages, the higher fertility levels of 90 kg N + 45kg P_2O_5 ha^{-1} (F_3) registered significantly highest in comparisons to other two(F_1 and F_2) treatments. It is perhaps due to significant role of nitrogenous and phosphatic fertilizer in growth and development of kalmegh. Among spacing, 40 cm row spacing ($S_{2)}$ recorded the highest Yield attributes in comparison to S_1 and S_3 which were at par with each other. It is due to ideal spacing required to survive the kalmegh while more or less spacing badly influenced the yield. Therefore, based on the research done, it can easily be recommended that in order to have high returns with yield and yield attributes of Kalmegh 90 kg N + 45kg P_2O_5 ha^{-1} (F_3) in combination with 40 cm row spacing (S_2) should be practiced.

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