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Research Article

INDIVIDUAL AND COMBINED EFFECT OF ORGANIC MANURE AND CHEMICAL FERTILIZERS ON GROWTH AND PRODUCTIVITY OF CHANDRASUR (*Lepidium sativum* L.) UNDER *Acacia mangium* BASED AGROFORESTRY SYSTEM

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Abstract- The experiment was conducted to study the individual and combined effect of organic manure and chemical fertilizers on growth and productivity of Chandrasur (*Lepidium sativum* L.) under *Acacia mangium* based Agroforestry system was carried out at Research Farm, Department of Forestry, IGAU, Raipur (C.G.). The design followed was randomized block design with three replications. The observations regarding morphological growth characters *viz*., plant height, number of leaves, collar diameter and number of branch. Yield attributes *viz*., seed yield plant^{-1}, seed test weight and seed yield hectare^{-1} were tabulated and analyzed statistically using randomized block design. The results revealed that the morphological characters of Chandrasur *viz.,* plant height (49.33 cm.), collar diameter (1.94 cm), number of leaves (30.33) and number of branch (14.33) were recorded maximum in treatment (T_7) 3 ton vermicompost combination with 18, 46 kg NP ha^{-1}. Farther the highest seed yield/plant (2.33 gram), Seed test weight (1.94 gram)and seed yield (7.23 q/ha) was recorded in (T_7) treatment 3 ton vermicompost combination with 18, 46 kg NP ha^{-1} was applied which is superior value among other treatments. However, minimum plant growth and productivity was observed in treatment T_8 (control) Chandrasur without intercropping as a sole crop.

Key words- Chandrasur, *Lepidium sativum,* Agroforestry, Intercropping, Vermicompost, FYM, organic manure, medicinal crop.

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Introduction

Agroforestry is a land use system that involves deliberate retention, introduction, or mixture of trees or other woody perennials in crop/animal production field to benefit from the resultant ecological and economical interactions. Silvi-agriculture system is one of the important Agroforestry system having medicinal plants as one of the components, in these systems shade is provided by trees in a natural forest to a commercial medicinal crop. Trees like *Tectona grandis, Shorea robusta, Gmelina arborea, Dalbergia sissoo, Acacia mangium, Eucalyptus* sp., *Acacia catechu, Santalum album* etc. are important component of forest based silvi-agriculture practices.

In Chhattisgarh, many important medicinal plants like *Chlorophytum borivilliam, Asparagus racemosus, Withania somnifera, Andrographis paniculata, Curcuma angustifolia* and other aromatic plants like Ban tulsi, lemon grass, khus grass are threatened due to injudicious and over exploitation. Therefore, the conservation of these species should be made through domestication and cultivation. These species generally prefer to grow under partial shade in natural habitat and this can be ensured by cultivation of these medicinal plants between inter spaces of trees under agroforestry systems. Cultivation of medicinal plants under commercial trees is a recent practice, which needs through understanding of the interaction of trees with medicinal crops and thus location specific experiments are required to device suitable management practices and evolve a set of package of practices for economic cultivation of herbal crops. Chandrasur (*Lepidium sativum* L.) is an edible underutilized medicinal plant belonging to the family Cruciferae. 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 [12]. Seeds, leaves and roots are the economic parts of this crop. However, the crop is mainly cultivated for seeds in India [5]. In India, it is grown mainly in Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra. Apart from India, it is also cultivated in North America and parts of Europe. The seeds are known to contain a light yellow colored fixed oil and alkaloids such as lepidin, glucotropeolin, besides sinapin and sinapic acid. These seeds are good source to enhance the milk percentage in cattle as well as in nursing mothers. They are mainly used in Ayurveda, Unani and Siddha systems of medicine used as thermogenic, depurative, galactagogue, tonic, aphrodisiac, ophthalmic, antiscorbutic, antiasthamatic, diuretic etc. Fresh leaves and young seedlings are mainly used as spice and are rich source of glucosinolates and also used as salads. Roots are bitter, acrid and are useful in treatment of secondary syphilis.

*Acacia mangium*is a fast-growing tree species belonging to the family *Leguminosae*. *Acacia mangium* is an important multipurpose and nitrogen fixing tree species for low lands and one of major fast growing species used in plantation. It is naturalized in pacific and humid tropics of Australia. Due tolerance of very poor soils, *Acacia mangium* has continually important to sustainable supply of tree products *viz.,* fuel wood, timber, poles etc., while reducing the pressure on natural eco system. It produces a wood that can be used for variety of purpose. The timber is good for furniture, cabinets, etc and is also suitable for particle

board, plywood, firewood and charcoal etc. It is an ornamental plant planted along, road side or other urban areas. *A. mangium* grows well under low productivity land [10]. Its growth is affected by genetic as well as all environmental factors.

Integrated supply of nutrients to plants through combination of organic and inorganic sources is becoming increasingly important to protect the environment and quality of soil. Research on the influence of Farm Yard Manure, vermicompost and combined application of vermicompost and inorganic fertilizers on growth and productivity of Chandrasur seed yield is meagre. Keeping this in view, the present experiment was conducted to study the individual and combined effect of organic manure and chemical fertilizers on growth and productivity of Chandrasur (*Lepidium sativum* L.) under *Acacia mangium* based Agroforestry system.

Materials and Methods

The experiment was conducted on experimental farm of forestry Department, Indira Gandhi Agriculture University Raipur Chhattisgarh. The climate of the study area is dry sub-humid tropical with an average rainfall of 1250 mm. Most of the rainfall (90%) is received during monsoon season from mid June to mid September. The average number of rainy days varies from 65 to 79. The meteorological data ranges from experiment time in maximum temperature 30.34^{0}C and minimum temp. 20.92^{0}C, relative humidity 90.6%, sun shine 7.52 hours and the rainfall 57.4 mm was recorded in sowing time of seed on October month and the harvesting time temperature and sun shine was increases. Maximum temperature 41.75^{0}C and min. temp. 25.05, relative humidity 39.75%, sun shine 9.3 hours recorded in month of April.

The black clayey soil of experimental field belongs to the order Vertisols and it is locally known as Kanhar. This Kanhar soil are characterized by fine texture, sticky nature, angular blocky structure, low to medium Nitrogen, high Potassium and low to medium Phosphorus with low Organic matter. The soil of experimental area is very rich in organic carbon and other nutrient because of the addition of litter in the soil every year.

Chandrasur (*Lepidium sativum* L.) was sown as intercrop under *A. mangium* tree as well as sole crop (without tree). The different combinations of farm yard manure (FYM), vermicompost and fertilizers were applied prior to planting and thoroughly mixed with the soil in a year with single splits under *Acacia mangium* based Agroforestry system. Plot size 3 x 3 m were demarcated in such a way that two trees come in each plot laid for 7 different treatments in 8th treatment plots were made in open field without tree. The seed sown on the line with spacing 10 cm plant to plant and 30 cm row to row in all the plots prepared for the experiment.

The experiment was laid out in a randomized block design (RBD) with eight treatments and three replications. The trial was conducted with organic manure of FYM 6 ton ha^{-1} and Vermicompost 3 ton ha^{-1} along with combination of fertilizers (Recommended dose of fertilizer RDF) @ 18:46 kg N and P_2O_5 ha^{-1}. The treatments comprised of T_1 – 6 ton FYM ha^{-1}; T_2 – 3 ton vermicompost ha^{-1}; T_3 (FYM 50% + Vermicompost 100%); T_4 (FYM 50% + Vermicompost 50%); T_5 (FYM 100% + RDF 100%); T_6 (FYM 50% + RDF 100%); T_7 (Vermicompost 100% + RDF 100%) and T_8 (control) without tree sole crop.

At the time of field preparation and before sowing of seed in each plot has been treated with the particular treatment according to the designed layout and as per recommended quantity of manure/fertilizer. Basal dose: 9 kg N & 46 kg P_2O_5 ha^{-1} in the form of urea and super phosphate, N is applied in 3 split dozes after 60 days 4.5 Kg and 120 days 4.5 kg ha^{-1}. Basal dose of fertilizers combination with organic manure were mixed in treatment T_5, T_6 and T_7 plots with shade respectively.

The observations regarding physiological growth characters *viz*., Plant height, Number of leaves, Number of Branch, and Collar diameter. Yield attributes *viz*., Number of seed plant^{-1}, Seed test weight and Seed yield hectare^{-1} were analyzed statistically using randomized block design at 5% level of significance.

Results and Discussion

The results of the present study have been presented and discussed under the following headings:

Growth parameters:

The data on the plant height, collar diameter, number of branches and number of leaves are presented in [Table-1] and [Fig-1] indicated that all studied growth characters were significantly affected by application of FYM, vermicompost and inorganic fertilizer alone or their combinations in Chandrasur crop.

Table-1 *Average effect of organic manure and combination with inorganic fertilizer treatments on growth and productivity of Chandrasur under Agroforestry System*

Treatments	Plant height (cm)	Collar diameter (mm)	Number of leaf	Number of branch	Test weight (g)	Seed yield per plant (g)	Yield (q/hq)
T1	39.33	1.40	20.33	12.00	1.67	1.33	6.50
T2	46.33	1.83	26.33	13.67	1.57	2.22	6.93
T3	47.67	1.87	28.67	14.00	1.93	2.29	7.13
T4	42.33	1.53	21.33	12.33	1.40	1.77	6.47
T5	45.67	1.73	25.67	13.00	1.70	2.03	5.03
T6	43.67	1.63	24.67	12.67	1.87	2.19	6.80
T7	49.33	1.94	30.33	14.33	1.94	2.33	7.23
T8	33.33	0.97	19.33	9.17	1.23	1.30	5.60
Sem (±)	3.09	0.19	1.86	0.95	0.15	0.25	0.46
CD (at 5%)	9.36	0.58	5.65	2.88	0.46	0.75	1.39

T_1 - 6 Ton FYM (Farm yard manure), T_2 - 3 Ton Vermicompost, T_3 - 3 Ton FYM + 3 Ton Vermi compost, T_4 - 3 Ton FYM + 1.5 Ton Vermi compost, T_5 - 6 Ton FYM + 18, 46 kg NP ha^{-1}, T_6 - 3 Ton FYM + 18, 46 kg NP ha^{-1}, T_7 - 3 Ton Vermi compost + 18, 46 kg NP ha^{-1}, T_8 (Control) without tree, g = Gram, q = quintal, Cm = Centimeter, mm = millimeter, hq = hectare

The Maximum average plant height of Chandrasur was recorded in T_7 (49.33cm) treatment 100% Vermi compost + RDF, followed by T_3 (47.67cm) treatment FYM 50% + Vermicompost 100% and minimum average plant height was observed in T_8 (33.33cm) control without intercropping sole crop. A similar trend was observed in collar diameter of Chandrasur crop [Table-1]. The Maximum average collar diameter of Chandrasur was recorded in T_7 (1.94 cm) treatment 100% Vermi compost + RDF, followed by T_3 (1.87 cm) treatment in interaction effects. The minimum collar diameter was observed in T_8 (0.97 cm) control as sole crop. Plant height and collar diameter was significantly higher with combined application of vermicompost and inorganic fertilizer compared with control. In the present study, combined application of vermicompost and NP fertilizers, resulted in good production in all treatments due to proper supplied of nutrients and soil conditions conducive for plant growth. The increase in plant height and plant growth might be due to beneficial effect of vermicompost in improving the soil environment which in turn encourages proliferous root growth resulting in better absorption of moisture, nutrients and thus producing maximum plant height [2,7,9].

The integrated use of organic and chemical fertilizers exhibited significant effects on growth parameters [Table-1] Among the different treatments tried, T_7 (100% Vermi compost + RDF) recorded the highest number of leaves plant^{-1} and number of branch plant^{-1} (30.33 and 14.33) followed by T_3 (50% FYM + 100%

Vermicompost), which recorded (28.67 and 14.00) number of leaves and branch plant^{-1}. The least number of leaves and branch (19.33 and 9.17) was recorded in T_8 (control) sole crop. The combined effect of inorganic source and vermicompost played a very important role due to their synergistic effect. Application of vermicompost increased the supply of easily assimilated major as well as micronutrients to plants besides mobilizing unavailable nutrients into available form.Similarly results reported that the combined application of vermicompost with half dose of recommended fertilizer NPK recorded significantly higher biomass yield than the organic source applied alone in Geranium (*Pelargonium Graveolens*) crop[6, 7].

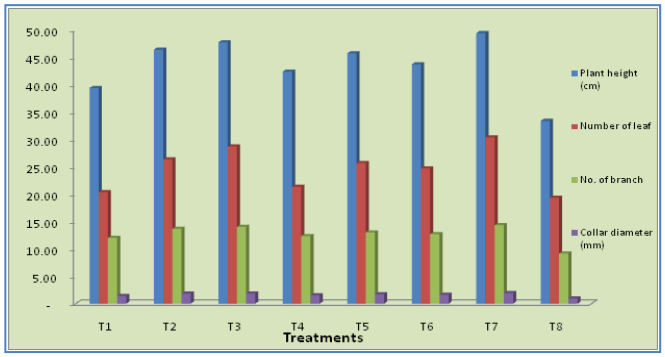

Fig-1 Effect of organic manure and combination with inorganic fertilizer treatments on morphological characters of Chandrasur under Agroforestry System.

Yield attributes

After harvest the seed yield was computed and presented in [Table-1] and [Fig-2]. Number of seed plant^{-1}, seed test weight and seed yield hectare^{-1}showed statistically significant ($P<0.05$) by organic manure and fertilizer treatments under Agroforestry system and as a sole crop in open condition without trees.

Significant differences were observed among the treatments with regard to number of seed yield per plant and seed test weight of Chandrasur crop. The maximum number of seed yield per plant and seed test weight (2.33g and 1.94g) was observed in T_7 (100% Vermi compost + Recommended dose of fertilizer RDF) followed by T_3 (50% FYM + 100% Vermicompost) which recorded (2.29g and 1.93) number of seed yield per plant. The least number of seed yield per plant (1.30g and 1.23g) was observed in T_8 (control) sole crop. Such variation in seed test weight has also been reported earlier ranging from 1.78 g to 1.98 g in different accessions of *L. sativum* [1]. Variation in test seed weight among various accessions is known in other plant species like *Carthamustinctorius* [11]. The combined effect of inorganic source and vermicompost played a very important role due to their synergistic effect.

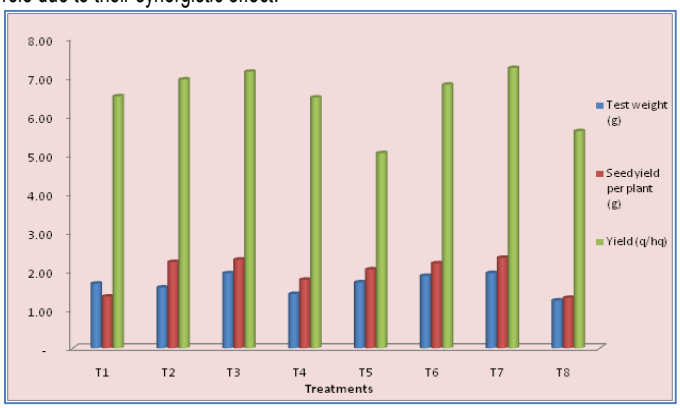

Fig-2 Effect of organic manure and combination with inorganic fertilizer treatments on seed test weight and seed yield of Chandrasur under Agroforestry System.

A similar trend was observed with seed yields. The highest seed yield per hectare (7.23q/ha) was recorded in T_7 (100% Vermi compost + RDF). The next best value for seed yield per hectare (7.13q/ha) was recorded in T_3 (50% FYM + 100% Vermicompost), while the least value (5.60q/ha) was recorded in T_8(control) without tree sole crop. The combined application of inorganic fertilizers and organic manures might have supplied adequate amounts of nutrients, which favored higher metabolic rate and auxin activities in the plant, resulting in better yield attributes and higher seed yield. Similarly reported that the combined application of vermicompost and recommended dose of fertilizer recorded significantly seed yield than the organic source applied alone in coriander (*Coriandrum sativum* L.) crop [3,7]. A combination of organic and inorganic sources of nutrients might be helpful to obtain a good economic return with good soil health for the subsequent crop yield [4].

The most important elements present in inorganic fertilizers are nitrogen, phosphorus, and potassium which influence vegetative and reproductive phase of plant growth. Compared to inorganic fertilizers the organic fertilizer having lowered the nutrient content, solubility, and nutrient release rates are typically low than inorganic fertilizers and therefore inorganic fertilizers are more preferred than organic fertilizers. Besides this application of organic manures not only produced the highest and sustainable crop yield, but also improved the soil fertility and productivity of land.

Conclusion

From the present investigation, it can be concluded that 3 ton vermi compost + 18 kg nitrogen and 46 kg phosphorus, vermi compost and their combination are the best organic sources for Chandrasur seed production, when compared to other sources of organic and inorganic nutrients under *Acacia mangium* based Agroforestry system as compare with the sole crop without tree and recommended to cultivate this crop under tree based Agroforestry system for higher income. The application of Vermi compost before the sowing of Chandrasur seed produced a beneficial effect on crop growth. Because of their availability and capacity to supply macro as well as micronutrients, the vermicompost combine with inorganic fertilizer, tree litter fall and other organic materials can supplement the nutritional requirements of the Chandrasur crop.

Application of research: Application of vermicompost increased the supply of easily assimilated major as well as micronutrients to plants besides mobilizing unavailable nutrients into available form.

Research Category: Agroforestry

Abbreviations:

FYM: Farm Yard Manure
RDF: Recommended dose of fertilizer

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Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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