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EFFECT OF TREE SPACING AND ORGANIC MANURES ON GROWTH PARAMETERS OF *DIANTHUS BARBATUS L.* UNDER *GREWIA OPTIVA* DRUMMOND. BASED AGROFORESTRY SYSTEM

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Abstract- The study was carried out with the objectives to study the effect of tree spacing and organic manures on growth parameters of *Dianthus barbatus* L (sweet William). Study revealed that maximum plant height, maximum plant spread and number of side stems was recorded in open condition as compared to agroforestry system. Organic manures like FYM, vermicompost, enhanced the growth parameters both in open condition and within agroforestry system. Study also revealed that tree based farming system can be one of the viable alternative land use system to prevent further degradation of land due to soil erosion and obtain production on sustainable basis.

Key words- Agroforestry system, *Dianthus barbatus,* farming system, FYM, Growth parameters, sustainable, land use system, and Organic manures.

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Introduction

Agroforestry is not a new concept, nor is it a new technology. For centuries, agroforestry has been practiced around the world and is most commonly associated with tropical and sub-tropical regions. Agroforestry is an intensive land-management system that optimizes the benefits from the biological interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock [4]. It is an emerging concept and technology that bridges production agriculture and natural resource conservation with environmental enhancement and human needs.

Tree based farming system can be one of the viable alternative land use system to prevent further degradation of land due to soil erosion and obtain production on sustainable basis. Among various tree used in agroforestry, *Grewia optiva* Drummond. is an important multipurpose tree. It belongs to family *Tiliaceae* and is one of the most important fodder trees of north-western Himalaya. According to [2] *Grewia optiva* is distributed throughout the sub-Himalayan tract, found up to an altitude of 1800 m. It is sparingly found in forest area and is mostly raised along agriculture fields, and is heavily lopped for palatable fodder. It is very popular among the farmers of western Himalayas for feeding their productive cattle during the winter period when no other green fodder is available.

Dianthus barbatus [Sweet William] is a species of *Dianthus* native to southern Europe and parts of Asia which has become a popular ornamental garden plant. It belongs to a family Caryophyllaceae. It is a herbaceous biennial or short-lived perennial plant growing to 30–75 cm tall, with flowers in a dense cluster of up to 30 at the top of the stems. Each flower is 2–3 cm diameter with five petals displaying serrated edges. It grows to 30–75 cm tall, with green to glaucous blue-green tapered leaves 4–10 cm long and 1–2 cm broad. The flowers are produced in a dense cluster of up to 30 at the top of the stems and have a spicy, clove-like scent; each flower is 2–3 cm diameter with five petals with serrated edges; in wild plants the petals are red with a white base.

Though flower cultivation has been practiced in India since time immemorial, but floriculture has blossomed into a viable business only in recent years. Availability of diverse agro-climatic conditions in this large country facilitates production of all major flowers throughout the year in some part or the other, and improved transportation facilities, have increased the availability of flowers all over the country. India has made noticeable advancement in the production of flowers. Floriculture is estimated to cover an area of 2.55 lakh **ha** with a production of 17.50 lakh MT of loose flowers and 5.43 lakh MT cut flowers [8]. Organic farming comprises of diversified agriculture techniques like intercropping, crop rotation, green manuring, organic manures (FYM and compost), organic residues; biofertilizers etc. organic manures include farmyard manure, vermicompost, biofertilizers, green manures etc. Most commonly used organic manure is FYM in which cattle dung constitutes the major source of nutrients and contains 0.72, 0.35 and 0.80 percent N, P and K respectively. Similarly, vermicompost enrich the soil by improving the residual build up of organic carbon and available N, P and K in soil. Vermicompost greatly increased surface areas, providing more microsites for microbial decomposing organisms and strong adsorption and retention of nutrients [12]. Vermicompost have many outstanding biological properties like bacteria, actinomycetes, fungi and cellulose degrading bacteria [14]. Therefore integration of flower crop in the agroforestry system may prove one of the best viable cultural practices to improve the socio-economic status of the small land holding farmers in North Western Himalaya.

Materials and Methods

The study was conducted at the experimental field of Department of Silviculture and Agroforestry, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) during the years 2012 – 2013. An agroforestry system comprises of *Grewia optiva* + *Dianthus barbatus* was developed to study the effect of different tree spacing and organic manure on growth, parameters of winter flower annual [*Dianthus barbatus* L.] The *Grewia optiva* was planted in July 2004 at different spacing (plant to plant-1m, 2m and 3m apart and rows 8m apart). *Dianthus barbatus* is an important winter annual flower was sown as intercrop and applied with eight manure doses i.e. 5.00 kg FYM (T_1),3.00 kg vermicompost (T_2), 5.00 kg municipal solid waste (T_3), PGPR(T_4), 5.00 kg FYM + PGPR (T_5), 3.00 kg vermicompost + PGPR (T_6), 5.00 kg municipal solid waste + PGPR (T_7) and control (T_8 without manures) per plot. Size of the plot was 1m× 1m. Nursery raised seedlings of Dianthus *barbatus* were transplanted in the system during the month of November 2013. The study was undertaken in the year 2013-14 Data were recorded for various growth parameters from December 2013 – April 2014.

Table–1 *Effect of tree spacing and organic manures on growth parameters of Godetia Grandiflora under Grewia optiva Drummond. based agroforestry system.*

Spacing / Treatment	Plant height (cm)					Plant spread (cm^2)					Number of side stems				
	S_1	S_2	S_3	S_0	Mean	S_1	S_2	S_3	S_0	Mean	S_1	S_2	S_3	S_0	Mean
T_1 (5 kg FYM)	48.70	50.69	52.10	52.89	**51.09**	26.33	24.46	25.66	29.14	**26.40**	5.66	5.77	5.56	5.97	**5.74**
T_2 (3 kg VC)	48.07	50.01	52.71	53.50	**51.07**	26.08	25.44	28.22	30.21	**27.49**	5.76	5.64	5.83	6.61	**5.96**
T_3(5 kg MSW)	48.40	49.55	50.90	52.46	**50.33**	26.72	28.94	28.77	28.13	**28.14**	5.22	5.25	5.50	6.44	**5.60**
T_4 PGPR	44.53	45.00	45.72	47.11	**45.59**	23.44	22.05	23.31	25.11	**23.48**	4.67	4.90	5.03	5.05	**4.91**
T_5 (PGPR +FYM)	49.25	50.14	51.50	52.18	**50.77**	27.47	28.22	26.50	29.61	**27.95**	5.44	5.25	5.90	5.97	**5.64**
T_6 (PGPR +VC)	49.05	50.43	51.83	53.38	**51.17**	26.91	27.44	27.66	30.00	**28.00**	5.39	5.85	6.00	6.27	**5.88**
T_7 (PGPR +MSW)	48.43	49.63	51.00	51.60	**50.17**	28.89	28.72	28.22	29.00	**28.70**	5.51	4.83	5.83	6.22	**5.60**
T_8 (NO MANURES)	43.44	44.27	45.31	46.77	**44.95**	23.02	23.49	23.89	20.72	**22.78**	4.60	4.29	4.01	3.39	**4.07**
Mean	**47.48**	**48.72**	**50.13**	**51.24**	**49.39**	**26.11**	**26.09**	**26.53**	**27.74**	**26.62**	**5.28**	**5.22**	**5.46**	**5.74**	**5.43**
$CD_{(0.05)}$	**T**		**0.58**					**0.79**					**0.25**		
	S		**0.41**					**0.69**					**0.18**		
	T×S		**NS**					**1.94**					**0.50**		

S_1: 1 meter tree spacing, S_2: 2 meter tree spacing, S_3: 3 meter tree spacing, S_0: open condition

FYM: Farm Yard Manure, VC: Vermicompost, MSW: Municipal Solid Waste, PGPR: Plant Growth Promoting Rhizobacteria

Experiment was laid in a split - plot design.

Results and Discussion

Plant height of *Dianthus barbatus* [sweet William] was significantly affected by tree spacing and organic manures. Among different tree spacing; maximum (51.24 cm) plant height was recorded in spacing S_0 and minimum (47.48 cm) was recorded in S_1. Among different doses of organic manures maximum (51.17 cm) plant height was recorded in T_6 which was statistically at par with T_1 (51.09 cm), T_2 (51.07 cm) and T_5 (50.77 cm) and minimum (44.95 cm) was recorded in treatment T_8. Interaction effect between treatment and spacing (T×S) showed a non significant effect on plant height. The results of the present investigation indicate that plant height was increased with the increase in the tree spacing; plant height was recorded less in (S_1) tree spacing whereas it was found higher in open condition (S_0). The negative effect in close vicinity of trees can be ascribed to more competition for light which is also evident from the present study. These results are in line with the findings of [10] where they that closer spacing of *Grewia optiva* suppressing the height of *Calendula officinalis.* Similar results were obtained by [11] and [3] where they reported that the less light in intercultivated wheat crop due to the shade during the initial growth period. Organic manures like Vermicompost, FYM and Municipal solid waste influences the plant height as compare to the control these results are in conformity with the findings of [10] where they reported that organic manures like FYM and vermicompost was found best in respect of plant height of *Calendula officinalis* under *Grewia optiva* based agroforestry system . Similar results were also reported by [1], [9] and [13] where they reported that media consist of red soil + FYM [1:1] was found to be best in respect of plant height of marigold.

Perusal of the data presented in [Table-1] revealed that both spacing and organic manures showed significant effect on plant spread. Among spacing maximum (27.74 cm^2) plant spread was recorded in S_0 and minimum (26.09 cm^2) was recorded in spacing S_2. Organic manures showed a significant effect on the plant spread; maximum (28.70 cm^2) plant spread was recorded in T_7 which was found statistically at par with the T_6, T_5 and T_3 while minimum (20.72 cm^2) was recorded in T_8. Interaction effect of treatment and spacing (T×S) exhibits a significant effect on the plant spread; maximum (30.21 cm^2) plant spread was recorded in treatment combination T_2S_0 which was closely followed by T_5S_0, T_6S_0, T_7S_0, T_1S_0, T_5S_0, T_3S_2, T_3S_3, T_7S_1 and T_7S_2 whereas, minimum (20.72 cm^2) was recorded in treatment combination T_8S_0. Less spread of *Dianthus barbatus* plants under *Grewia optiva* canopy than open may be due to competition for resources and modified micro-environmental conditions. The higher plant spread at wider tree spacing probably due to higher production of photosynthates and the productivity of under story is affected due to influenced physiological process. [7] recorded lower production of photosynthates under low light conditions for longer periods, thus, resulting in low plant growth. The results of present study are in line with the finding of [6] and [10] who also reported widest plant spread along with the longest flowering duration.

Content of the data presented in the [Table-1] revealed that spacing and organic manure registered a significant effect on the number of side stems. Among spacing's maximum (5.74) number of side stems was recorded in S_0 and minimum (5.22) was recorded in S_2. Among different doses of organic manures; maximum (5.96) number of side shoots was recorded in T_2 which was found statistically at par with the T_1 and T_6 and minimum (4.07) was recorded in T_8. Cumulative effect of treatment and spacing showed a significant effect on the number of side stems; maximum (6.61) number of side stems was recorded in T_2S_0 which was found statistically at par with treatment combination T_3S_0, T_6S_0 and T_7S_0 while, minimum (3.39) was recorded in T_8S_0. This could be attributed to better flow of various micro and macro nutrient along with the plant growth substances into the plant system. There by it might have favored for stimulation and production of auxiliary buds resulting in formation of more number of stems. The above said results are also corroborated with the findings of [5] in marigold and [10] in *Calendula officinalis* intercrops with *Grewia optiva.*

Conclusion

The investigation revealed that with increase in the tree spacing growth parameters like plant height, plant spread and number of side stems increases. Intercropping of flower crop with *Grewia optiva* provides an excellent agroforestry system to enhance the socioeconomic status of the farmers. This system can be a viable option to replace the traditional agroforestry system.

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