



EFFECT OF TREE SPACING AND ORGANIC MANURES ON GROWTH PARAMETERS OF *GODETIA GRANDIFLORA* 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 *Godetia grandiflora* L. Study revealed that growth parameters of *Godetia grandiflora* were suppressed under the close spacing. 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 and vermicompost enhanced the growth parameters both in open condition and within agroforestry system. Integrating winter annual flower crop with *Grewia optiva* offers an excellent opportunity for the framers to earn more income than the monoculture.

Key words- *Godetia grandiflora*, growth parameters, organic manures, income, monoculture, agroforestry system, Farmyard manure and vermicompost.

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Introduction

Land-use options that increase livelihood security and reduce vulnerability to climate and environmental change are necessary. Traditional resource management adaptations, such as agroforestry systems, may potentially provide options for improvement in livelihoods through simultaneous production of food, fodder and firewood as well as mitigation of the impact of climate change [1]. Reframing the challenge in another way, agroforestry systems may provide part of the answer to a central challenge for sustainability on how to conserve forest ecosystems and farmland biodiversity as well as the services that they provide while simultaneously enhancing food production for an increasing population under the condition of land and water scarcity [2]. Livelihoods improvement is not just about the positive change towards better quality of life and human well-being but it takes into account the local and global change which determines livelihoods.

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 trees used in agroforestry, *Grewia optiva* Drummond. is an important multipurpose tree being retained or deliberately planted in various agroforestry systems in Western Himalayas [3] and [4]. It belongs to family *Tiliaceae* and is one of the most important fodder trees of north-western Himalayas. According to [5] *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 [6]. In recent times various *Grewia optiva* based agroforestry systems, have been developed and evaluated for their economic feasibility [7] and [8].

Apart from grains, pulses, medicinal and aromatic plants floriculture etc. is destined to play an important role in socio-economic transformation of marginal lands in more productive agrarian economy. Growing of flower in agroforestry will open new vistas for research and development. Himachal Pradesh is state where

temperature is vary from 0°C to 39°C and produce often a offseason flowers in India when there is dearth period for the flower production. *Godetia grandiflora* is a dwarf to medium height plant 30-70 cm with large flowers produced in a clusters. 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 Himachal Pradesh. Inter-cultivation of *Godetia* under tree canopy will open vistas for enhanced economics in changed land-use system.

Material and Method

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* + *Godetia grandiflora* was developed to study the effect of different tree spacing and organic manure on growth, parameters of winter flower annual (*godetia grandiflora* L.) The *Grewia optiva* was planted in July, 2004 at different spacing [plant to plant-1m [S₁], 2m [S₂] and 3m [S₃] apart and open condition (S₀) with tree rows 8m apart. *Godetia grandiflora* an important winter annual flower was sown as intercrop and applied with eight manure doses i.e. 5.00 kg FYM (T₁), 3.00 kg vermicompost (T₂), 5.00 kg municipal solid waste (T₃), PGPR(T₄), 5.00 kg FYM + PGPR (T₅), 3.00 kg vermicompost + PGPR (T₆), 5.00 kg municipal solid waste + PGPR (T₇) and control (T₈ without manures) per plot. Size of the plot was 1m × 1m. Nursery raised seedlings of *Godetia grandiflora* were transplanted in the system during the month of November 2012. Data were recorded for various growth parameters from December 2012 – April 2013. Experiment was laid in a split - plot design.

Results and Discussion

Plant height was significantly affected by tree spacing and organic manures. Among different tree spacing maximum (60.50 cm) was recorded in S₀ [open condition and minimum (56.79 cm) was recorded in S₁. Among different doses of organic manures; maximum (61.77 cm) plant height was recorded in T₆ whereas

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)	56.97	58.83	59.97	61.39	59.29	39.29	39.92	41.35	42.75	40.83	8.38	8.62	8.62	9.25	8.72
T ₂ (3 kg VC)	58.48	59.58	60.70	62.67	60.36	40.05	41.50	41.45	44.05	41.76	8.80	9.02	9.01	9.45	9.07
T ₃ (5 kg MSW)	55.70	56.40	58.00	60.20	57.58	38.10	36.44	38.27	40.44	38.31	8.05	8.15	8.17	8.68	8.26
T ₄ PGPR	55.67	57.57	57.25	59.25	57.43	35.93	36.55	33.25	38.32	36.01	7.77	7.75	7.98	8.33	7.96
T ₅ (PGPR +FYM)	58.20	61.19	61.38	63.72	61.12	38.63	41.15	40.82	43.14	40.94	8.52	8.52	8.88	9.50	8.85
T ₆ (PGPR +VC)	58.77	60.65	62.11	65.57	61.77	40.65	42.05	43.88	44.61	42.80	9.00	9.22	9.22	9.73	9.29
T ₇ (PGPR +MSW)	57.13	58.12	59.92	62.03	59.30	37.07	37.95	39.38	40.61	38.75	8.13	8.40	8.53	8.92	8.50
T ₈ (NO MANURES)	53.42	52.05	51.00	49.17	51.41	34.58	36.23	32.47	32.66	33.99	7.63	8.29	8.02	7.38	7.83
Mean	56.79	58.05	58.79	60.50	58.53	38.04	38.98	38.86	40.82	39.17	8.28	8.50	8.55	8.91	8.56

CD_{0.05}

T 0.64
S 0.46
T×S 1.29

T 0.95
S 0.67
T×S 1.90

T 0.09
S 0.06
T×S 0.17

(S₁): 1 meter tree spacing, (S₂): 2 meter tree spacing, (S₃): 3 meter tree spacing, (S₀): open condition
FYM; Farm Yard Manure, VC: Vermicompost, MSW: Municipal Solid Waste, PGPR: Plant Growth Promoting Rhizobacteria

minimum (53.00 cm) was recorded in T_8 . Cumulative effect of treatment and spacing $[T \times S]$; maximum (65.57 cm) plant height was recorded in treatment combination T_6S_0 and minimum (49.17 cm) was recorded in T_8S_0 . The results of present investigation can be endorsed with the finding of [9] where they reported that plant height of *Calendula officinalis* L. was more in the wider spacings this may be due to the shade in 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 [9] 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 [10] in marigold.

Tree spacing and organic manure had a significant effect on the plant spread of *Godetia grandiflora* during the year of study., it has been noticed that maximum (40.82 cm²) plant spread was recorded in S_0 i.e. open condition and minimum (38.04 cm²) was recorded in S_1 . Among different doses of organic manure maximum (42.80 cm²) plant spread was recorded in T_6 and minimum (33.99 cm²) was recorded in T_8 . Cumulative effect of the treatment and spacing ($T \times S$) shows a significant effect on the plant spread maximum (44.61 cm²) plant spread was recorded in treatment combination T_6S_0 which was found statistically at par with the T_6S_3 , T_5S_0 , T_2S_0 , and T_1S_0 , minimum (32.47 cm²) was recorded in treatment combination T_8S_3 . Higher plant spread was recorded in open condition (S_0) whereas; less plant spread was recorded in S_1 . Less spread of *Godetia grandiflora* 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. [11] 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 [12] who also reported widest plant spread along with the longest flowering duration.

Number of side stems was significantly influenced by the tree spacing and organic manures., Among different tree spacing maximum (8.91) number of side stems were recorded in S_0 whereas, minimum (8.28) was recorded in S_1 . Among different doses of organic manures maximum (9.29) number of side stems was recorded in T_6 and minimum (7.83) number of side stems was recorded in T_8 . Combined effect of treatment and spacing ($T \times S$) shows significant effect on the number of side stems maximum (9.73) number of side stems was recorded in treatment combination T_6S_0 and minimum (7.38) was recorded in treatment combination T_8S_0 . Organic manures effect reveals that higher numbers of stems were recorded in T_6 as compared to the control. 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 [13] in marigold and [9] 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 farmer as well as the socioeconomic status of the country.

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