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Effect of Spacing on Growth Attributes and Socio-economic Benefits of Marigold (*Tagetes species*) under Subabul (*Leucaena leucocephala*) based Agroforestry System

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A B S T R A C T

The experiment was carried out in the Forest Nursery and Research farm, Department of Agroforestry, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. The experiment was laid out in a Randomized Block Design (2×4 factorial) having eight treatments and three replications. The finding of the research revealed that floral characters were maximum in T7 (S4V1) [*Tagetes erecta* (antigua)] with spacing 35 × 65 cm and yield parameter was maximum in T1 (S1V1) [*Tagetes erecta* (antigua)] with spacing 35 × 35 cm and also advantage and return in terms of cost benefit ratio, treatment T1 (S1V1)[*Tagetes erecta* (antigua)] with spacing 35 × 35 cm is best among all the treatments. Thus according to this experiment *Tagetes erecta* is better than *Tagetes patula* in most of the parameters under Subabul (*Leucaena leucocephala*) based Agroforestry system in Allahabad conditions.

Introduction

Agroforestry is an ancient land use practice of growing trees in association with crops. Trees play an important role in ecosystem in all terrestrials and provide a range of products and services to rural and urban people. As natural vegetation is cut for agriculture and other types of development, the benefits that trees provide are best sustained by integrating trees into agricultural system. The perennial woody plants provide direct and indirect benefits like food, fuel, fodder, fertilizer, fibre, timber, shade, oxygen, windbreak, harbour wild life and improve microclimate and agricultural crops provides staple food to people. Agroforestry in true sense has been realized as the need of hour. It does not confine to regional, geographical or agro-climatic boundaries. The term Agroforestry is

now internationally used as an umbrella term for all the multiple land use system. Subabul (*Leucaena leucocephala*) is capable of growing in diversified agro climatic conditions of tropical region and it also fixes atmospheric nitrogen equivalent to one tone of ammonium sulphate per hectare per year assuming 1000 trees per hectare. It is widely regarded as one of the most versatile of all tropical multipurpose trees because of exceptionally high rates of growth, disease and pest resistance, the rapid decomposition of its foliage makes Subabul an excellent mulch (surface application) or green manure crop. *Leucacena* can also contribute to erosion control. *Tagetes* is a genus of annual or perennial, mostly herbaceous plants (family- Asteraceae), it was described as a genus by Carl Linnaeus in 1753. It deter some common insect pests, as well as nematodes hence often used in companion planting for tomato, eggplant, chili pepper, tobacco, and potato. Marigolds are highly useful for medicinal purposes such as headaches, toothache, swelling, and strengthening the heart. Tagetes contains ingredients that might help decrease swelling (inflammation) and spasms, calm the nerves, and reduce blood pressure. Marigold also had a number of uses for culinary purposes; in fact, the name 'pot Marigold' refers back to the tradition of adding Marigold to the cooking pot. *Tagetes erecta* (Variety-Antigua), the Mexican marigold, also called Aztec marigold and it has a naturally basal-branching, dwarf growth habit. It has dark-green foliage and golf ball sized, double blooms in true orange or bright, clear yellow. The plant grows up to 25-30cm (10-12") high and spreads to 25-30cm (10-12") wide. It is planted as seed or as nursery-grown seedlings. The dark green ferny foliage has a distinctive aromatic smell. *Tagetes patula* a French marigold is with several naturalised populations around the world. In some climates it flowers from July to October. In its native habitat of the highlands of central Mexico, blooms are produced from September to killing frost. Achenes ripen and are shed within two weeks of the start of bloom. The heads contain mostly hermaphrodite (having both male and female organs) florets and are pollinated primarily by beetles in the wild, as well as by tachinid flies and other insects. The leaves of all species of marigold include oil glands. The oils are pungent.

Materials and Methods

The experimental was conducted at the research and nursery area of the Department of Agroforestry, Sam Higginbottom Institute of Agriculture, Technology and Sciences. (Formerly Allahabad Agricultural Institute) Allahabad (U.P) which is situated at an elevation of 90.85 m above the mean sea level, at 28.87°N latitude and 81.15°E longitude. During the winter months especially December and January, temperature drops down to as low as 3 - 5°C, while in the summer temperature reaches above 45 – 48^{0}C. Hot scorching winds are a regular feature during the summer whereas there may be an occasional spell of frost during the winter. The annual rainfall is 1100 mm, mostly during the monsoon autumn.

The mechanical and chemical analysis of soil from the experimental Fields was done to examine the fertility status and mechanical composition of soil structure. The soil samples were collected randomly from experimental field with the help of soil augur from surface to 12-18 cm depth. The soil samples were air-dried finally powder and thoroughly mixed. Then a representative soil sample of 5 g was taken for each mechanical and chemical analysis. The experiment was laid out in Randomized Block Design (2×4 factorial) with 8 treatments and 3 replications. The different treatments were allocated in each replication. The different treatments

have 4 spacing (i.e. 35 × 35 cm, 35 × 45cm, 35 × 55cm and 35 × 65cm) with 2 species of marigold [i.e. *Tagetes erecta* (antigua) and *Tagetes patula* (jafri)].

Treatment combination

T1: S1 + V1
T2: S1 + V2
T3: S2 + V1
T4: S2 + V2
T5: S3 + V1
T6: S3 + V2
T7: S4 + V1
T8: S4 + V2

WHERE,

V1= *Tagetes erecta* (antigua)
V2= *Tagetes patula* (jafri)
S1= 35 × 35 cm
S2=35 × 45cm
S3=35 × 55 cm
S4=35 × 65 cm

Observations recorded

Plant parameters

Number of days required for first flower bud emergence from transplanting

First flower bud appearance in each plant was noted soon after the flower buds were visible. To record the first flower bud appearance, the plants were observed critically and after emergence the buds are tagged. Days for flower bud appearance were calculated from transplanting date to flower bud appearance date.

Number of flowers per plant

Number of flowers harvested during the period of flowering was recorded and total number of flower calculated for all pickings.

Diameter of flower head (cm)

The diameter of fully opened flowers was measured and expressed in cm.

Flower yield (t/ha)

The weight of flower produced was recorded from the first to last harvest per plot and flower yield per plot was calculated. The flower yield per hectare was calculated on the basis of yield per plot.

Tree parameters

Height of tree (m)

Height of the subabul tree was measured by measuring tape and expressed in meter (m). The average height of tree before transplantation is 1.10 m and after it is 1.72 m.

Collar diameter (cm)

The average collar diameter of subabul before transplantation is 5.52 cm and after it is 5.56 cm.

Specific gravity

Specific gravity of Subabul is 0.45-0.55.

Results and Discussion

Floral characters

Number of days required for 1st flower bud emergence from transplanting (days)

Data presented in Fig 1 highlights the significant influence of spacing on days taken to flower bud initiation while, species and interaction between spacing and species treatment was found non-significant.

The maximum number of days taken to first flower bud initiation i.e. 42.3 days in (S1V1) *Tagetes erecta* (antigua) and 40.6 days in (S1V2) *Tagetes patula* (jafri) were found in closer spacing 35 × 35 cm while, minimum number of days taken to first flower bud initiation i.e. 32.3 days in (S4V1) *Tagetes erecta* (antigua) and 30.7 days in (S4V2) *Tagetes patula* (jafri) were noted with wider spacing 35 × 65 cm. As in comparison of both the species maximum number of days taken to first flower bud initiation were found in *Tagetes erecta* (42.27) with spacing 35 × 35 cm and minimum number of days required for first flower initiation is in *Tagetes patula* (30.73) with spacing 35 × 65 cm, thus bud appear first in *Tagetes patula* than *Tagetes erecta* in all spacing.

Number of flowers per plant

Perusal of the data in Fig 2 revealed the significant influence of spacing, species and also influence of interaction between spacing and species is also significant in number of flowers per plant in *Tagetes erecta* and *Tagetes patula* under *Leucaena leucocephala* based Agroforestry system.

The maximum numbers of flowers were found is 36.8 in (S4V2)*Tagetes patula* (jafri) with spacing 35 × 65 cm, followed by 36.3 in (S3V2)*Tagetes patula* (jafri) with spacing 35 × 55 cm. The flowers of *Tagetes patula* (jafri) was small in size and more in number than *Tagetes erecta* (antigua) in all the treatments. The minimum number of flowers were found is 23.5 in (S1V1)*Tagetes erecta* (antigua) with spacing 35 × 35 cm.

In all treatments of both species as the spacing increases the number of flowers increases, this might be due to less competition within the plants for light, nutrients, air, water, etc.

Diameter of flower head (cm)

Different spacing and species of marigold significantly influenced the diameter of flower head but the interaction between spacing and marigold species were non-significant in *Tagetes erecta* and *Tagetes patula* under *Leucaena leucocephala* based Agroforestry system.

The data pertaining to diameter of flower head (Fig 3) revealed that diameter of flower head were found to increase by increasing the spacing. The maximum diameter of flower head i.e. 9.7 cm were recorded in treatment S4 V1[*Tagetes erecta* (antigua)] with wider spacing 35 × 65 cm followed by treatment S3V1 (9.5 cm) [*Tagetes erecta* (antigua)] with spacing 35 × 55 cm while minimum diameter of flower head were recorded in treatment S1V2 (3.1 cm) [*Tagetes patula* (jafri)] with spacing 35 × 35 cm. The flower size of *Tagetes erecta* is more than *Tagetes patula* so diameter of flower head of *Tagetes erecta* is more than *Tagetes patula* in all the treatments.

Yield character

Flower yield (t/ha)

Spacing, species and interaction between spacing and species significantly influenced the flower yield (t/ha) in *Tagetes erecta* and *Tagetes patula* under *Leucaena leucocephala* based Agroforestry system. The data in Fig 4 clearly indicated that the flower yield per plot decreased significantly with increase in the planting distance. Significantly maximum flower yield per plot i.e. 12.0 t/ha in S1V1 [*Tagetes erecta* (antigua)] with closer spacing 35 × 35 cm followed by treatment S2V1 (11.9 t/ha) [*Tagetes erecta* (antigua)] with spacing 35 × 45 cm while minimum flower yield per plot were recorded in treatment S4V2 (6.3 t/ha) [*Tagetes patula* (jafri)] with spacing 35 × 65 cm (Table 1 and 2).

Figure.1 Effect of spacing on number of days required for 1st flower bud emergence from transplanting of *Tagetes erecta* and *Tagetes patula* under Subabul (*Leucaena leucocephala)* based Agroforestry system

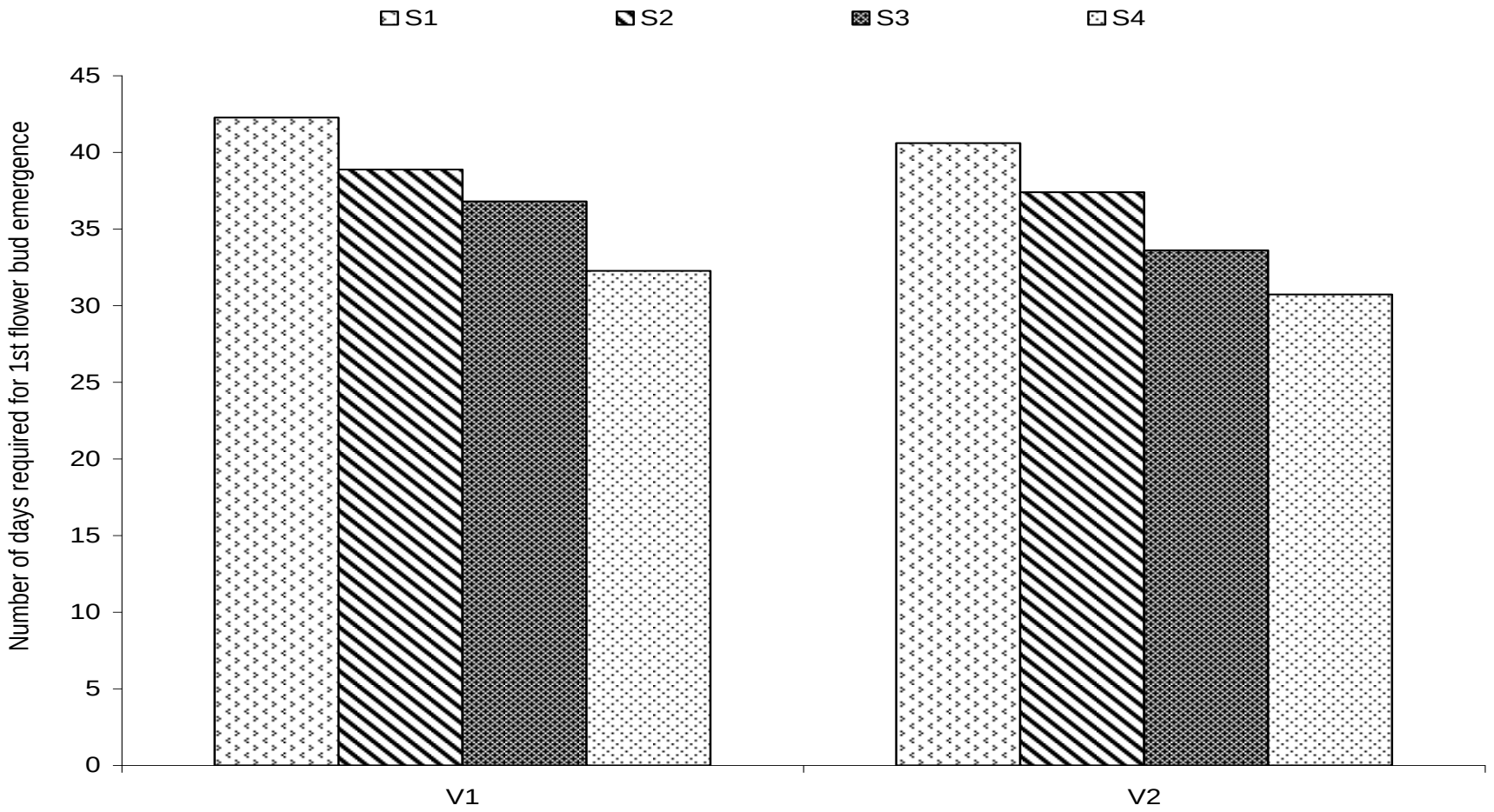


Figure.2 Effect of spacing on number of flowers per plant of *Tagetes erecta* and *Tagetes patula* under Subabul (*Leucaena leucocephala)* based Agroforestry system

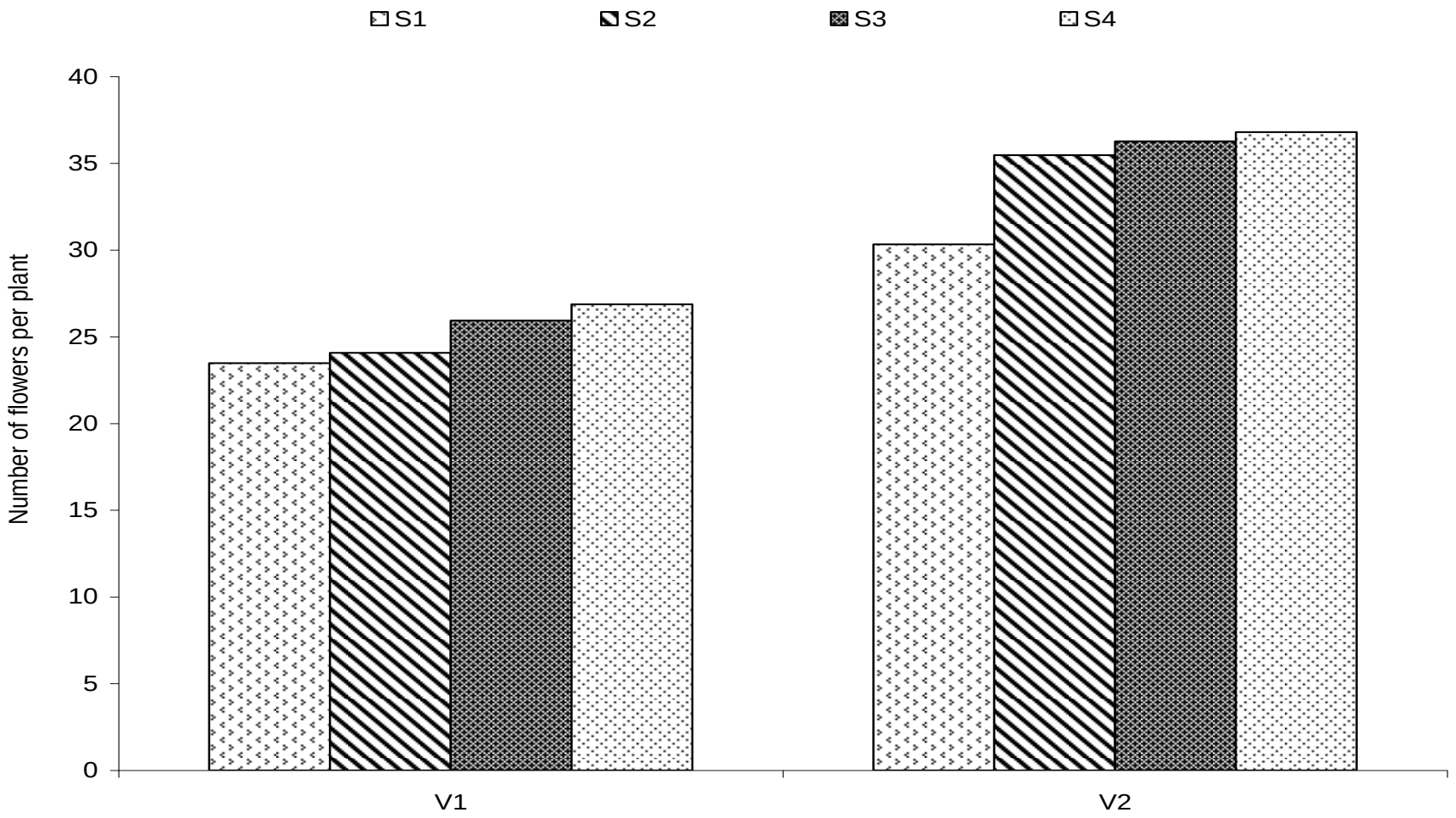


Figure.3 Effect of spacing on diameter of flower head (cm) of *Tagetes erecta* and *Tagetes patula* under Subabul (*Leucaena leucocephala)* Based Agroforestry system

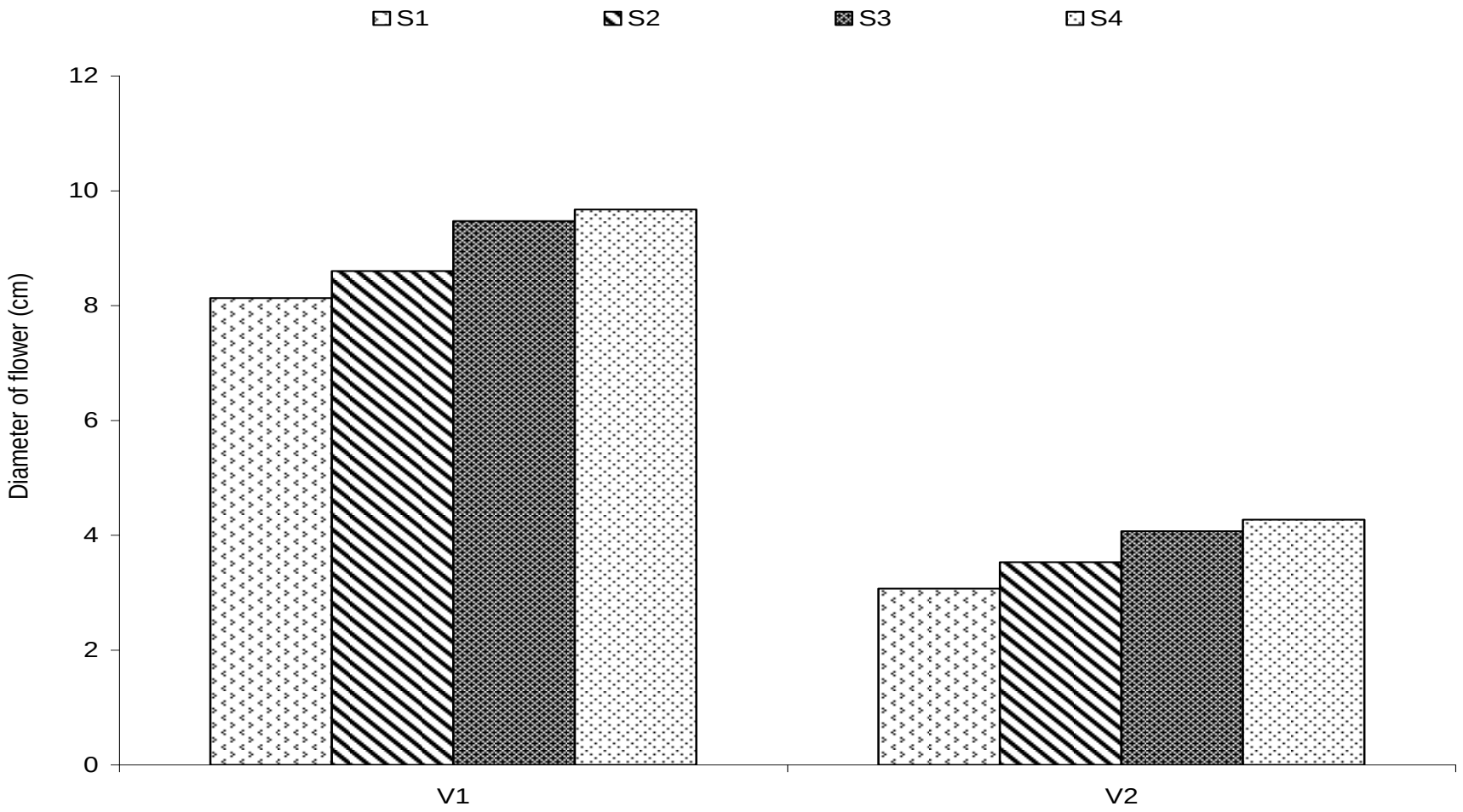
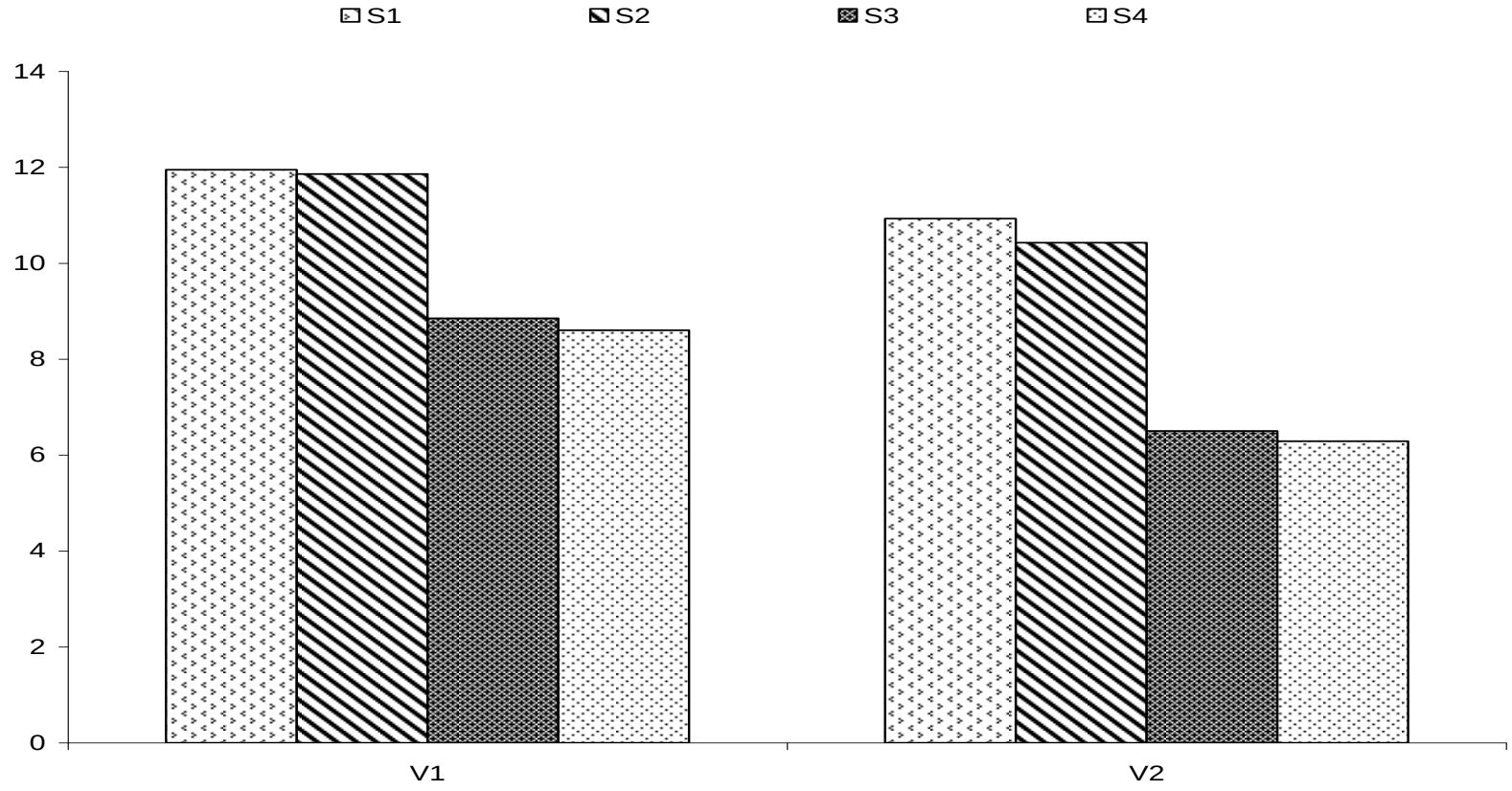


Figure.4 Effect of spacing on flower yield (t/ha) of *Tagetes erecta* and *Tagetes patula* under Subabul (*Leucaena leucocephala)* Based Agroforestry system



Economic Analysis

Table.1 Fixed cost of cultivation of *Tagetes erecta* and *Tagetes patula* under Subabul (*Leucaena leucocephala*) based Agroforestry system

S.No.	Particulars	Unit	Qty.	Rate/unit(Rs)	Cost(Rs/ha)
A.	Land preparation				
1	Ploughing with M.B plough	Hrs	4	500	2000
2	Disc Harrow	Hrs	4	500	2000
3	Planking and leveling	Hrs	2	400	800
4	Layout of the field	Labour	25	200	5000
B.	Seed and transplantation				
1	Cost of seed	Kg	1.5	6000	9000
2	Transplantation	Labour	20	200	4000
C.	After care				
1	Gap filling	Labour	8	200	1600
2	Weeding(5 weeding 4 labour)	Labour	20	200	4000
D.	Irrigation				
1	Tubewell [5 irri.(2hr/irri)]	Hrs	10	300	3000
2	Labour for irrigation	Labour	20	200	4000
E.	Picking and other operation (6 labour for 5 days)	Labour	30	200	6000
F.	Pruning of Subabul	Labour	25	200	5000
G.	Transportation charges				4000
H.	Supervision & imputed value of family labour	Months	3	3000	9000 + 1200
I.	Rental value on land	Months	3	600	1800
J.	Interest on fixed cost (12.5%)				1200
K.	Insurance charges				1850
L.	Interest on working capital (9.5%)				4047
	Total fixed cost				69497

Table.2 Cost Benefit Ratio of *Tagetes erecta*, *Tagetes patula* and Subabul (*Leucaena leucocephala)* in Agroforestry system

Treatment	Yield of Marigold flowers (t/ha)	Rate of flowers @ Rs/tone	Total Amount of flowers (Rs)	Yield of Subabul (fuelwood) (t/ha)	Rate of fuelwood@ Rs/tone	Total Amount of fuelwood (Rs)	Gross Return (Rs/ha)	Total cost of cultivation (Rs/ha)	Net profit (Rs/ha)	Cost benefit ratio (C:B)
T1	11.95	18000	215100	8.648	4000	34592	249692	69497	180195	3.59
T2	10.93	10000	109300	8.648	4000	34592	143892	69497	74395	2.07
T3	11.85	18000	213300	8.648	4000	34592	247892	69497	178395	3.56
T4	10.43	10000	104300	8.648	4000	34592	138892	69497	69395	1.99
T5	8.85	18000	159300	8.648	4000	34592	193892	69497	124395	2.78
T6	6.50	10000	65000	8.648	4000	34592	99592	69497	30095	1.43
T7	8.60	18000	154800	8.648	4000	34592	189392	69497	119895	2.72
T8	6.29	10000	62900	8.648	4000	34592	97492	69497	27995	1.40

It is concluded from the experiment that most of the floral characters were maximum in *Tagetes erecta* (antigua) with spacing 35 × 65 cm (S4V1) and yield parameter was maximum in *Tagetes erecta* (antigua) with spacing 35 × 35 cm (S1V1). Thus according to this experiment *Tagetes erecta* is better than *Tagetes patula* in most of the parameters .However based on advantage and return in terms of cost benefit ratio, *Tagetes erecta* with spacing 35 × 35 cm is best among all the treatments under Subabul (*Leucaena leucocephala*) based Agroforestry system.

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