Online ISSN 2456-6489

Research Article

Indian Journal of Agroforestry
Vol. 27, No. 2, April–June 2025

Performance of Intercrops Under Fodder Tree Species Based Agroforestry System in Northern Transitional Zone of Dharwad Region of Karnataka

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https://doi.org/10.48165/ija.2025.27.02.12

ARTICLE INFO
Received: 06.02.2023
Accepted: 10.06.2025

Keywords:
Intercrop
Fodder tree species
Root nodule
Agroforestry system
Soil moisture

ABSTRACT

The present field investigation was carried out in existing fodder plantation for two years during kharif and rabi seasons of 2018-19 and 2019-20 to study the effect of different fodder tree species on intercrops (Soybean and Safflower) grown under fodder tree based agroforestry system at University of Agricultural Sciences, Dharwad, Karnataka. The experiment was laid out in Randomized Block Design (RBD) with three replications in an established plantation. Fodder trees were planted at a spacing of 5 × 3 m and the plot size was 15 × 12 m with 12 trees per treatment with two intercrops soybean (kharif season) and safflower (rabi season) in the interspaces. During kharif season, the yield attributes of soybean (number of pods, seed weight, hundred seed weight, seed yield and haulm yield) were noticed highest values in sole soybean (T8). Whereas, Albizia lebbeck + Soybean (T2) recorded maximum values among agroforestry systems during both the periods of investigation. The highest number of root nodules and weight of root nodules were recorded in soybean as sole crop (T8) and Albizia lebbeck + Soybean (T2) agroforestry system. During rabi season, the yield attributes of safflower (number of capitula, seed yield and haulm yield) were recorded maximum values in sole safflower (T8). Among agroforestry systems, Moringa oleifera + Safflower (T6) noticed maximum values during both the periods of investigation. The fodder tree based agroforestry systems reported a significant influence on soil moisture (%) with soybean and safflower intercrops in different growth stages (20, 40, 60 DAS and at harvest) during study periods which indicated that water in the soil helps in performance of field crops. Soil moisture (%) under soybean crop showed decreasing trend from 20 DAS to harvesting stage. The pooled data showed that sole soybean crop (T8) has registered the highest seed yield and haulm yield (571.21 kg ha-1 and 457.02 kg ha-1) among all the agroforestry systems followed by Albizia lebbeck + Soybean (T) (513.57 kg ha-1 and 427.87 kg ha-1) and T - Calliandra calothyrsus

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+ Soybean (465.04 kg ha-1 and 402.89 kg ha-1) whereas Sesbania grandiflora + Soybean (T) has

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expressed a poor performance with the least production of soybean seed yield and haulm yield of

330.21 kg ha-1 and 260.80 kg ha-1 among the agroforestry systems respectively. The pooled data indicated that sole safflower crop (T8) significantly registered the highest seed yield and haulm yield (477.71 kg ha-1 and 12177 kg ha-1) as compared to agroforestry systems respectively. Among fodder tree based agroforestry systems, Moringa oleifera + Safflower (T6) registered significantly higher values of seed yield haulm yield (358.00 kg ha-1and 9244.50 kg ha-1) followed by T - Albizia

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lebbeck + Safflower (339.71 kg ha-1 and 8508 kg ha-1). The combination of Calliandra calothyrsus

+ Safflower (T) was having the lowest seed yield and haulm yield value (237.78 kg ha-1

INTRODUCTION

Agroforestry components or intercrops differ significantly in size and growth of the smaller understorey species may be occupied by shading as well as competition for water and nutrients. In various tropical conditions, water (*e.g.* semiarid regions) or nutrient accessibility (*e.g.* acidic, leached or degraded soils) is the most important restrictive aspect rather than light (Rao *et al.,* 1998). A species which establish early has benefit in light capture during more rapid early shoot growth may also display greater root growth and thus capture resource due to improved accessibility of photosynthates. The reduction in soybean yield is due to presence of trees may be attributed to differential pattern of canopy spread resulting in variation in light interception and competition of the tree roots for moisture and nutrients. It is well recognized that the effects of trees when grown in close proximity to field crops may be complementary or competitive which result in increase or reduction of yield of agricultural crops. Soybean is a valuable crop now gaining importance due its industrial value. While, Safflower is an important oil seed crop of the tract grown under residual soil moisture conditions in rabi season. The transition tract of Karnataka with an annual rainfall of 750-800 mm fairly well distributed from June to October, offers a good condition for cultivation of soybean under black soil. Hence, soybean becomes a sustainable crop in agroforestry systems. The safflower crop has tremendous potential to be grown under varied conditions and to be exploited for various

purposes, the area under safflower around the world is limited, largely due to the lack of information on its crop management and product development from it. Aboveground resource contribution of light and space is dependent upon the age of the tree species and crops.

The quantity of light interception of trees depends on

the amount of incident and portion of light intercepted through tree canopy and low light intensity is one of the significant restraints for superior yield. The extent of shading to annual crops enhances with an increase in the portion of land occupied by trees in agroforestry. Therefore, the present investigation was undertaken to know the effect of different fodder tree species on intercrops (soybean and safflower) under fodder tree species based agroforestry systems

2. MATERIALS AND METHODS

The present field investigation was carried out in an existing fodder plantation for two years during kharif and rabi seasons of 2018-19 and 2019-20 to study the effect of fodder tree species on soybean Var. JS-335 and safflower *Var.* Annigeri-1under agroforestry systems at the premises of University of Agricultural Sciences, Dharwad, Karnataka. Seven fodder tree species were planted at a spacing of 5 × 3m, *viz*., *Calliandra calothyrsus*, *Albizia lebbeck*, *Leucaena leucocephala*, *Sesbania grandiflora*, *Gliricidia sepium, Moringa oleifera* and *Bauhinia purpurea* during 2014. The experiment was laid out in Randomized Block Design (RBD) with three replications in an established plantation**.** Fodder trees were planted at a spacing of 5 × 3 m and the plot size was 15 × 12 m with 12 trees per treatment with intercrops in the interspaces.

Observations on Soybean

Number of nodules on the plant roots was counted from 5 plants at 40 days after sowing and at harvest and the mean number of nodules per plant was worked out. Weight of nodules on the plant roots was recorded from 5 plants at 40 days after sowing and at harvest and expressed as gram per plant. Weight of seed yield from net plot was recorded and expressed in kilogram per hectare. Haulm yield was calculated by deducting the weight of seed from the total weight of crop and expressed in kilogram per hectare.

Observations on safflower

Weight of seed yield from net plot was recorded and expressed in kilogram per hectare. Haulm yield was calculated by deducting the weight of seed from the total weight of crop and expressed in kilogram per hectare.

Harvest index of the soybean and safflower crops was calculated as per the following standard formula. Harvest index =

Seed yield Biological yield (seed + haulm**)** The intercrops (soybean and safflower) under

different fodder tree species were harvested in each plot by cutting the plants close to the ground. Harvesting was done at physiological maturity stage of the crops. After harvesting, plants were bundled and allowed for sun drying. The seeds were separated from the dried plants by threshing and winnowing. Later the seeds were cleaned and weighed.

3. RESULTS AND DISCUSSION

Table 1

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Yield and yield components of intercrops under agroforestry systems Yield and yield components of Soybean

The data of observations during the periods of investigation (2018 and 2019) showed that seed yield (kg ha-1) of soybean recorded highest in T - soybean sole crop (571.21 kg ha-1) and T - *Albizia lebbeck* + Soybean (513.57 kg ha-1) compared to other treatment combinations studied. The treatment *Sesbania grandiflora* + Soybean (T4) consistently recorded least seed yield of 330.21 kg ha-1among the agroforestry systems (Figure 1).

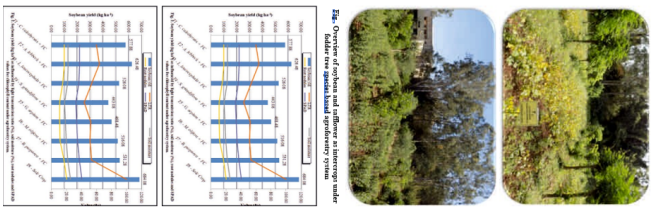


Figure 1

Among different fodder tree based agroforestry systems, the results showed a significant variation in seed yield during 2018 and 2019. a significant reduction in soybean seed yield was noticed during 2019 as compared to 2018. Maximum seed yield of soybean was recorded in T8 - Sole crop (684.08 and

458.33 kg ha-1) during 2018 and 2019 respectively. Among fodder tree based agroforestry systems, *Albizia lebbeck* + Soybean (T2) registered significantly higher seed yield (626.48 and 400.65 kg ha-1), while the lowest seed yield was recorded in *Sesbania grandiflora* + Soybean (T4) during 2018 and 2019 respectively (Table 1).

The higher number of nodules noticed in soybean under T2 - *Albizia lebbeck* + Soybean (20.99 and 31.42) followed by T1 - *Calliandra calothyrsus* + Soybean

Age of the fodder tree plantation – 5 years (2018) and 6 years (2019)

Age of the fodder tree plantation – 5 years (2018) and 6 years (2019)

Values above diagonal indicates correlation of soybean yield with dependent variables Values below diagonal indicates correlation of safflower yield with dependent variables

* Significant at $P < 0.05$

**Significant at $P < 0.01$

(20.50 and 30.35) greatly influenced growth of soybean at 40 DAS and at harvesting stage respectively. It was observed that number of nodules of soybean was significantly increased as the growth advanced from 40 DAS to harvesting stage. The lower yield could be attributed to lesser number of nodules under T4 - *Sesbania grandiflora* + Soybean (12.33 and 19.86) at 40 DAS and at harvest.

Similarly, Shimada *et al.* (2012) suggested that if soybean nodules are allocated preferentially deeper (centimetres) in the soil profile, where more soil moisture is presumably available, N2-fixation could be maintained or buffered against mild or moderate water deficits. These results suggested a remarkable morphological adjustment measure of soybean that may be further exploited to maintain N2-fixation potential in superficially dry soils.

In both the periods (2018 and 2019) of investigation, higher yield of soybean under *Albizia lebbeck* + Soybean (T2) could be attributed to the highest soil moisture (28.74, 27.41, 25.97 and 22.09 %) in 2018

and (27.63, 26.57, 24.68 and 22.03 %) during 2019

recorded under the treatment *Albizia lebbeck* + Soybean (T2) at different growth stages (20, 40, 60 DAS and at harvest) as compared to other agroforestry systems. Lower soybean yield was attributed to low soil moisture under T4 - *Sesbania grandiflora* + Soybean (24.11, 22.76, 21.32 and 17.41 %) during

2018 and (22.98, 21.92, 19.97 and 17.27 %) during

2019. However, soybean as sole crop (T8) has recorded the maximum soybean yield as it retained highest soil moisture (30.81, 29.77, 27.80 and 25.02 %) at various stages of growth in 20, 40, 60 DAS and at harvest during both the years.

Higher soybean seed yield in *Albizia lebbeck* + Soybean (T2) may be attributed to less canopy structure and open branching habit of fodder tree species which in turn recorded higher LTR and intercepted radiation which attributed to increased number of pods per plant, seed weight and 100 seed weight which in turn on total dry matter accumulation. Hence, higher yield could also be supported by the highest light transmission ratio observed in T2 - *Albizia lebbeck* + soybean (82.73, 67.03 and 63.77 %) during

2018 and (75.37, 66.97 and 57.33 %) during 2019 at 20, 40 DAS and at harvest respectively which differed significantly from other fodder tree based agroforestry systems.

Among fodder tree based agroforestry systems, *Albizia lebbeck* + Soybean (T2) differed significantly with

Table 2: Seed yield, haulm yield and harvest index of soybean as influenced by fodder tree based agroforestry systems

Agroforestry system	2018			2019			Pooled		
	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index
T1 - *Calliandra calothyrsus* + Soybean	577.88	514.32	0.529	352.20	291.46	0.547	465.04	402.89	0.538
T2 - *Albizia lebbeck* + Soybean	626.48	545.14	0.535	400.65	310.59	0.563	513.57	427.87	0.549
T3 - *Leucaena leucocephala* + Soybean	526.08	457.79	0.535	300.33	255.33	0.540	413.21	356.56	0.538
T4 - *Sesbania grandiflora* + Soybean	443.08	376.66	0.541	217.33	144.94	0.600	330.21	260.80	0.570
T5 - *Gliricidia sepium* + Soybean	468.48	404.55	0.537	241.83	181.48	0.571	355.16	293.02	0.554
T6 - *Moringa oleifera* + Soybean	516.08	443.85	0.538	290.33	221.53	0.567	403.21	332.69	0.553
T7 - *Bauhinia purpurea* + Soybean	531.28	462.14	0.535	308.32	242.31	0.560	419.80	352.23	0.547
T8 - Sole Crop – Soybean	684.08	567.82	0.547	458.33	346.28	0.570	571.21	457.05	0.558
SEm ±	0.174	10.793	0.006	1.276	8.329	0.004	0.639	5.83	0.003
CD @ 5%	0.534	33.054	NS	3.907	25.507	0.014	1.958	17.86	NS

Table 3: Seed yield, haulm yield and harvest index of safflower as influenced by fodder tree based agroforestry systems

Agroforestry system	2018			2019			Pooled		
	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index
T1 - *Calliandra calothyrsus* + Safflower	290.38	7295	0.036	185.18	5342	0.034	237.78	6318.50	0.035
T2 - *Albizia lebbeck* + Safflower	392.58	9464	0.039	286.83	7552	0.037	339.71	8508.00	0.038
T3 - *Leucaena leucocephala* + Safflower	343.85	9270	0.038	238.10	6495	0.035	290.98	7882.50	0.037
T4 - *Sesbania grandiflora* + Safflower	388.38	9450	0.039	284.04	7471	0.037	336.21	8460.50	0.038
T5 - *Gliricidia sepium* + Safflower	378.18	9308	0.038	272.43	7390	0.036	325.31	8349.00	0.037
T6 - *Moringa oleifera* + Safflower	410.87	10309	0.039	305.12	8180	0.036	358.00	9244.50	0.037
T7 - *Bauhinia purpurea* + Safflower	368.38	9277	0.038	262.63	7313	0.035	315.51	8295.00	0.036
T8 - Sole Crop - Safflower	530.58	13212	0.040	424.83	11142	0.037	477.71	12177.00	0.038
SEm ±	1.279	151.28	0.001	1.454	149.36	0.001	1.340	126.65	0.001
CD @ 5%	3.916	463.29	NS	4.452	457.42	NS	4.120	387.89	NS

Table 4

higher seed yield followed by T1 - *Calliandra calothyrsus* + Soybean, *Bauhinia purpurea* + Soybean (T7) and *Leucaena leucocephala* + Soybean (T3), but recorded comparatively lesser values as compared to T - Sole soybean crop (571.21 kg ha-1). The main reasons for decrease in soybean yield under fodder tree based agroforestry systems were due to severe competition for moisture, light and nutrients by fodder tree components. The unfavourable effect of agrofoestry system

Table 5: Correlation analysis to study the effect of biophysical parameters and soil properties on the yield of field crops under fodder tree based agroforestry systems.

Variables	Soybean Yield (kg ha-1)	Light Interception (%)	Light Transmission Ratio (%)	SPAD values	Soil moisture (%)	Available N (kg ha-1)	Available P (kg ha-1)	Available K (kg ha-1)
Safflower Yield (kg ha-1)	1	0.154NS	0.867**	0.740**	0.766**	0.762**	0.857**	0.813**
Light Interception (%)	0.213NS	1	0.473*	0.483*	0.471*	-0.051NS	0.117NS	0.416*
Light Transmission Ratio (%)	0.957**	0.431*	1	0.717**	0.752**	0.545**	0.715**	0.907**
SPAD values	0.693**	0.438*	0.746**	1	0.926**	0.536**	0.649**	0.683**
Soil moisture (%)	0.749**	-0.221NS	0.580**	0.451*	1	0.493*	0.610**	0.704**
Available N (kg ha-1)	0.132NS	-0.008NS	0.241NS	0.005NS	-0.054NS	1	0.773**	0.506*
Available P (kg ha-1)	0.317NS	0.072NS	0.429*	0.089NS	-0.112NS	0.776**	1	0.657**
Available K (kg ha-1)	-0.006NS	0.171NS	0.007NS	0.107NS	0.015NS	-0.251NS	-0.246NS	1

Table 6

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on physiology and yield of intercrops was more prominent during vegetative stage than reproductive stage due to growth of the intercrops.

The reduction in soybean yield was due to a significant reduction in intercepted radiation in *Sesbania grandiflora* + Soybean (T4) with values 47.60, 48.73 and 43.60 per cent (2018) and 55.47, 47.93, 37.90 per cent in 2019 at different growth stages of soybean intercrop. The least values in *Sesbania grandiflora* + Soybean (T4) may be due to dense canopy cover and branching habit which allows lesser light intensity to pass through canopy to make it available to field crops which attributed to reduced number of pods per plant, seed weight and 100 seed weight which in turn resulted on total dry matter accumulation. These lower values are attributed to a significant reduction in intercepted radiation in *Sesbania grandiflora* + Soybean (T4) with values 47.60, 48.73 and 43.60 per

cent in 2018 and 55.47, 47.93, 37.90 per cent at

different growth stages of soybean intercrop. Soybean yield had a significant positive correlation with light transmission ratio (0.867), SPAD values (0.740), soil moisture (0.766), available N (0.762), available P (0.857) and available K (0.813) (Table 3).

The yield attributes (number of pods plant-1, seed weight and 100 seed weight, seed and haulm yield) of soybean were recorded comparatively more values in all the growth stages of soybean during the cropping period 2018 as compared to 2019. This could be attributed to normal rainfall received during 2018 which retained normal growth and yield of soybean crop as against more rainfall received during the period of 2019.

However, there was a reduction in growth and yield of soybean under fodder tree based agroforestry systems as compared to sole crop (control) during both the periods of investigation due to competition for resources *viz* moisture, nutrient and light in agroforestry system (Ong *et al.*, 1991 and Rao *et al.*, 1999). Similar findings of reduction in the yield of field crops grown with perennial components were reported by Chandrashekaraiah (1986), Sunderlin (1992) and Roder *et al.* (1995).

Puri and Bangarwa (1992) and Dhillon *et al.* (1998) have also observed a decline in yield of wheat below the tree canopy due to resource competition for soil moisture, nutrients and light intensity. Venkat Rao *et al.* (2006) reported that the degree of reduction in pod yield was 5.5 and 3.1 per cent in ground nut with *Tectona grandis* and *Tectona grandis* + *Leucaena leucocephala* as compared to ground nut grown with *Tectona grandis* + grass.

In a similar study, Inamati (2014) reported maximum soybean seed yield in DPS-4 + soybean followed by RAK-89 + soybean, RAK-90 + soybean and RAK-22

+ soybean among Pongamia source based agroforestry systems but recorded lower values as compared to sole soybean crop (control).

In another study, Patil (2010) reported that seed yield of sole legumes was highest in soybean, greengram, frenchbean and blackgram respectively. The degree of reduction of seed yield was 9.7, 28.6, 9.9 and 17.8 per cent with teak + soybean, teak + greengram, teak +

frenchbean and teak + blackgram, respectively as compared to their sole legumes.

Similarly, reduction in yields of maize, sorghum, sunflower and ground nut along tree lines were reported by Chandrashekaraiah (1986), Itnal (1987),

Bhat (1988), Nadagoud (1990) and Mutanal (1998). The decline in soybean seed yield in adjacent tree rows was because of the effect of tree shade and competition of their roots with crops for moisture and nutrients. Low light intensity and soil moisture have negative effects on crop growth resulting in decreased soybean yield.

The extent of reduction in soybean seed yield under fodder tree based agroforestry system was in the order of *Sesbania grandiflora* + Soybean (T4) > *Gliricidia sepium* + Soybean (T5) > *Moringa oleifera* + Soybean (T6) > *Leucaena leucocephala* + Soybean (T3) > *Bauhinia purpurea* + Soybean (T7) > *Calliandra calothyrsus* + Soybean (T1) > *Albizia lebbeck* + Soybean (T2).

Low light intensity and soil moisture also had negative effect on growth of intercrops leading to decrease in soybean yields under tree species. This decreased yield was due to the competition during the crop growth resulted in primitive closure of stomata to reduce transpiration loss. In addition, it also reduced carbon dioxide dispersion into the leaves thereby affecting photosynthesis, transpiration rate, partitioning of biomass from vegetative parts of economic parts and improved stomatal and mesophyll resistance in crop plants (Nygren and Killomaki 1993)

Yield and yield components of safflower

Among the study periods, the yield components *viz*., number of capitula, number of seeds capitulum-1, seed weight (g plant-1), hundred seed weight (g) and seed yield (kg ha-1) were comparatively attained higher values during 2018 than 2019. However, among fodder tree based agroforestry systems, *Moringa oleifera* + Safflower (T6) agroforestry system significantly registered higher number of capitula (12.13 plant-1), number of seeds (22.84 capitulum-1), seed weight (7.88 g plant-1), hundred seed weight (4.39

g) and seed yield (358.00 kg ha-1) among fodder tree based agroforestry systems (Figure 2).

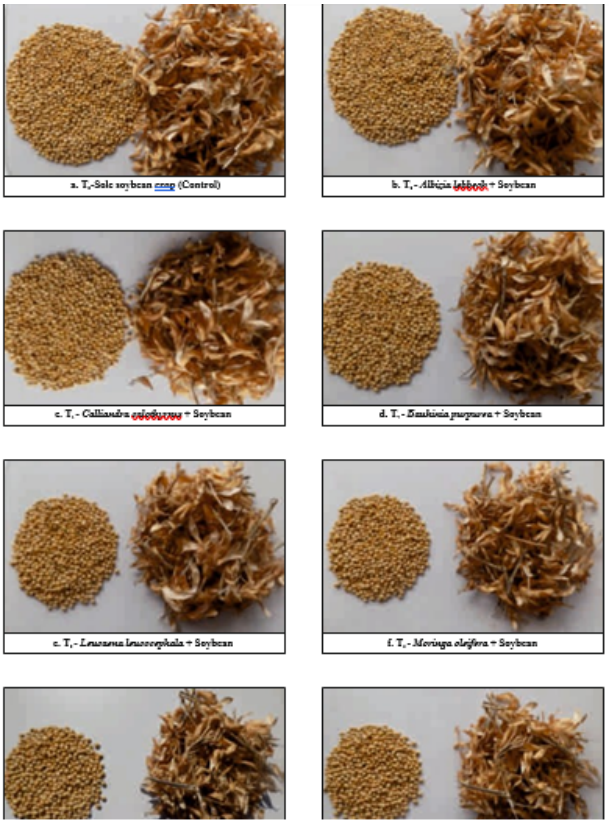


Figure 2: . Seed and haulm yield of soybean as an intercrop (highest to lowest) under different fodder tree based agroforestry systems

Among the cropping periods in different years of investigation, the period 2018 received normal rainfall retaining normal moisture after harvesting of kharif crops as compared to excess rainfall in 2019 (rabi season) retaining excess moisture. Hence, the conditions in 2018 resulted a positive effect on the growth attributes *viz*., plant height and number of branches and yield attributes *viz*., number of capitula (plant-1), number of seeds (capitulum-1), seed weight (g plant-1), hundred seed weight (g) and seed yield (kg ha-1) of safflower and in turn recorded comparatively more values in all the growth stages during the period 2018 as compared to 2019.

Among fodder tree based agroforestry systems, higher seed yield (410.87 and 305.12 kg ha-1) in *Moringa oleifera* + Safflower (T6) agroforestry system could have been influenced by higher light transmission ratio (85.33, 72.57 and 64.60 %) during 2018 and

(74.40, 65.47 and 59.73 %) during 2019 respectively. Further, increased safflower seed yield was also influenced by higher soil moisture content under *Moringa oleifera* + Safflower (T6) with higher values (14.71, 16.20, 18.93 and 12.42 %) in 2018 and (16.50,

18.94, 21.56 and 13.97 %) in 2019 at 20, 40, 60 DAS

and at harvesting stage respectively as compared to other agroforestry systems. Safflower yield showed a significant positive correlation with light transmission ratio (0.957), SPAD values (0.693) and soil moisture (0.749). However, available N (0.132) and available P (0.317) showed non significant positive correlation with

A drastic reduction in safflower seed yield (kg ha-1) was noticed during 2019 as compared to 2018 due to higher rainfall attaining excess moisture for rabi crop. The pooled data reported the highest seed yield in safflower sole crop (T8) with values 530.58 and 424.83 kg ha-1 during 2018 and 2019 respectively. Therefore, reduction in the seed yield of safflower (290.38 and 185.18 kg ha-1) under *Calliandra calothyrsus* + Safflower (T1) agroforestry system was attributed to minimum light transmission ratio (51.90, 42.03 and 47.30 %) in 2018 and (50.27, 38.63 and 39.77 %) in

2019 at different growth stages of safflower as compared to other agroforestry systems. So this reduction in yield of safflower under various fodder tree species under study is attributed to low light interception which could be attributed to reduction in photosynthesis rate and stomatal conduction.

These lower values were also attributed to reduction of soil moisture under *Calliandra calothyrsus* + Safflower (T1) with values such as 12.06, 13.55, 16.30

and 9.92 per cent during 2018 and 13.86, 16.30, 18.92 and 11.34 per cent during 2019 at various growth stages of safflower (20, 40, 60 DAS and harvest stage). Various researchers observed reduction in yield of

arable crops under agroforestry system to a larger extent after 4-5 year of planting (Singh and Korwar, 1986 and Kulkarni *et al.*, 1970). Similarly in the present study, seven year old fodder trees have attributed to yield reduction due to a well developed root system leading to competition for moisture and nutrient resources. The extent of reduction in seed yield and haulm yield of safflower observed 27.20 and

21.52 per cent in 2019 as compared to 2018 during the period of investigation.

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Correlation study of yield parameters with biophysical parameters and soil chemical properties

In order to study the influence of biophysical parameters and soil chemical properties on the yield of field crops and green tree fodder under agroforestry systems, a simple correlation analysis was carried out using Pearson's correlation coefficient. Soybean yield was positively correlated with light transmission ratio (0.867), SPAD values (0.740), soil moisture (0.766), available N (0.762), available P (0.857) and available K (0.813). The yield was significant at 1 per cent level. But light interception (0.154) showed non significant positive correlation with soybean yield (Table 3 and Fig 3).

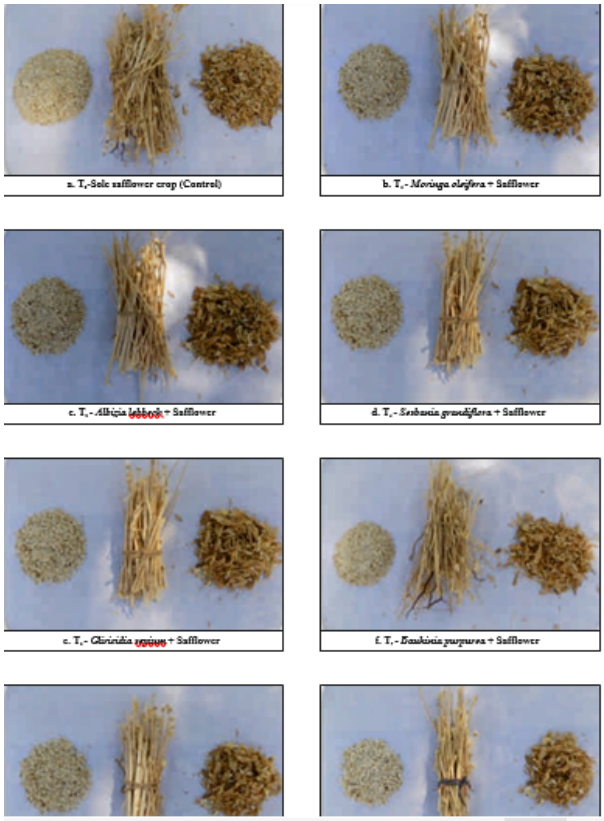


Figure 3: . Seed and haulm yield of safflower as an intercrop (highest to lowest) under fodder tree based agroforestry system

Safflower yield showed positive correlation with light transmission ratio (0.957), SPAD values (0.693) and soil moisture (0.749). The yield was significant at 1 per cent level. However, light interception (0.213) showed non significant positive correlation with safflower yield. Similarly, available N (0.132) and available P (0.317) also showed non significant positive correlation with safflower yield. But safflower yield was negatively correlated with available K (-0.006) (Table 3 and Fig 3).

4. CONCLUSION

The study revealed that during kharif season, the yield attributes of soybean (number of pods, seed weight, hundred seed weight, seed yield and haulm yield) were noticed highest values in sole soybean (T8). Whereas, *Albizia lebbeck* + Soybean (T2) recorded maximum values among agroforestry systems during both the periods of investigation. The highest number of root nodules and weight of root nodules were recorded in soybean as sole crop (T8) and *Albizia lebbeck* + Soybean soil moisture under *Calliandra calothyrsus* + (T2) agroforestry system. During rabi season, the yield attributes of safflower (number of capitula, seed yield and haulm yield) were recorded maximum values in sole safflower (T8). Among agroforestry systems, *Moringa oleifera* + Safflower (T6) noticed maximum values during both the periods of investigation

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How to Cite this Article: Shahapurmath G.B., Inamati S., Mutanal S.. (2025). Performance of Intercrops Under Fodder Tree Species Based Agroforestry System in Northern Transitional Zone of Dharwad Region of Karnataka. *Indian Journal of Agroforestry*, ***27***(2), 109-116. https://doi.org/10.48165/ija.2025.27.02.12