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The growth and oil yield performance of Karanj (*Pongamia pinnata*) under agroforestry system in plains of Chhattisgarh

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Abstract

The experiment entitled “The growth and Oil Yield Performance of Karanj under Agroforestry System in Plains of Chhattisgarh” was carried out at Herbal Garden of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2020-21. The cultivation of patchouli under Karanj based agroforestry system. The experiment was conducted during the month of November 2020 to May 2021. The tree height of Karanj recorded non-significant among different treatments. The tree height was ranging from 6.40 to 7.46 m, with the grand mean of 7.08 m. The tree diameter at breast height (DBH) recorded significantly higher with the treatment T₆ (15.38 cm) and was significantly least with the control (11.47 cm). The crown expansion was also found to be non-significant which was ranging from 7.55 to 6.80 m with the grand mean of 7.23 meter. The oil content extracted from Karanj recorded significantly higher with the treatment 4 (319.00 kg/ml) and the least was recorded with control (242.67 kg/ml) with the grand mean of 273.21 kg/ml.

Keywords: Agroforestry, Karanj (*Pongamia pinnata*)

Introduction

Agroforestry is a collective name for land use system and technologies where woody perennials (tree, shrubs, bamboos etc.) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. Agroforestry, or the planting of tree species and agricultural crops, is a centuries-old and still widely practiced worldwide. It refers to a wide range of land-use policies and systems. Karanj (*Pongamia pinnata*) is a multipurpose tree native to the humid tropics that grows quickly. Sangwan *et al.*, 2010; Orwa *et al.*, 2009) [9, 8] describe it as one of the few N-fixing trees that produces oilseeds. Significant quantities of oil cake are available for livestock feeding as oil demand for bio fuels rises. It is a deciduous tree that reaches a height of 15-20 meters in India and has a thick canopy that spreads out evenly. Early in the summer, the leaves are a light, shiny burgundy, maturing to a glossy, deep green as the season progresses. Throughout the year, small clusters of white, purple, and pink flowers bloom on their branches, maturing into brown seed pods.

The tree can withstand extreme heat and sunshine, and its thick, long taproot and dense network of lateral roots make it drought resistant. Karanj is becoming more common for oil production as a result of its use in biodiesel. George *et al.*, 2005; Wood *et al.*, 2001) [3, 11] used the oil for illumination, as a raw material for soaps, varnishes, and paints, to repel insects in storage installments, and as a mosquito repellent. Karanj wood can be used as a fuel source, with the ashes used as a dyeing agent. Pinnatin, a dyeing pigment, is produced by the roots. The bark has a fibrous texture and can be used to make rope. The leaves have the ability to be used as fodder. Pollen and nectar from the fragrant flowers are used by bees to make dark honey. The karanj tree is a common ornamental plant that attracts lac insects. Ethnomedicine uses several sections of the tree (Orwa *et al.*, 2009; Daniel, 1997) [8, 2]. The karanj tree is a significant afforestation plant. Leaf shedding generates a lot of organic litter (Morton, 1990) [6].

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Materials and Methods

The field experiment was laid out at Herbal Garden of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2014-15. Raipur is situated in Eastern Central part of C.G. at latitudes of 21° 16' N, longitude of 81° 36' E and 289.5 m above Mean Sea Level. The source of rainfall is south-western monsoon. It receives an average annual rainfall of 1326 mm (based on 80 years mean), mostly (85%) concentrated during the period of June to September. A few showers are expected during winters and occasionally during summer months. May is the hottest and December is the coolest month of the year. The weekly maximum temperature raised up to 46 °C during summer and minimum temperature reaches as low as to 6 °C during winter season. The soil of experimental field was clay to loam soil. Tree growth parameters the tree height was measured with the help of bamboo stick and measuring tape for different treatments. By comparing the preceding years' observations with present observations the percent

increment will be calculated. DBH (cm) The diameter measured at breast height on well grown tree-stalk. If it is branched before breast height, then it was measured at branching position. Crown expansion is the volume occupied by the canopy of the tree and is calculated as, Crown Volume (m³) = Canopy (m²) x Crown height (m).

Results and Discussion

1. Growth performance of Karanj (*Pongamia pinnata*) in agroforestry system

The tree height of Karanj recorded non-significant among different treatments. The tree height was ranging from 6.40 to 7.46 m, with the grand mean of 7.08 m. The tree diameter at breast height (DBH) recorded significantly higher with the treatment T₆ (15.38 cm) and was significantly least with the control (11.47 cm). The crown expansion was also found to be non-significant which was ranging from 7.55 to 6.80 m with the grand mean of 7.23 m and are presented in the Table 1. & Fig.1.

Table 1: Mean growth performance of Karanj (*Pongamia pinnata*) in agroforestry system

Treatment	Tree Height (m)	DBH (cm)	Crown Expansion(m)
T ₁	7.02	12.74	7.35
T ₂	6.86	13.83	7.65
T ₃	6.40	12.14	7.45
T ₄	7.23	14.32	7.55
T ₅	7.13	13.20	6.9
T ₆	7.13	15.38**	6.8
T ₇	7.46	13.34	7.4
T ₈	7.44	11.47	7.25
Mean	7.08	13.30	7.23
Sem	0.154	1.384	0.177
CV	5.539	8.843	5.775
CD @ 1%	NS	NS	NS
CD @ 5%	NS	2.060	NS

**Significant @ 5%; NS: Non significant

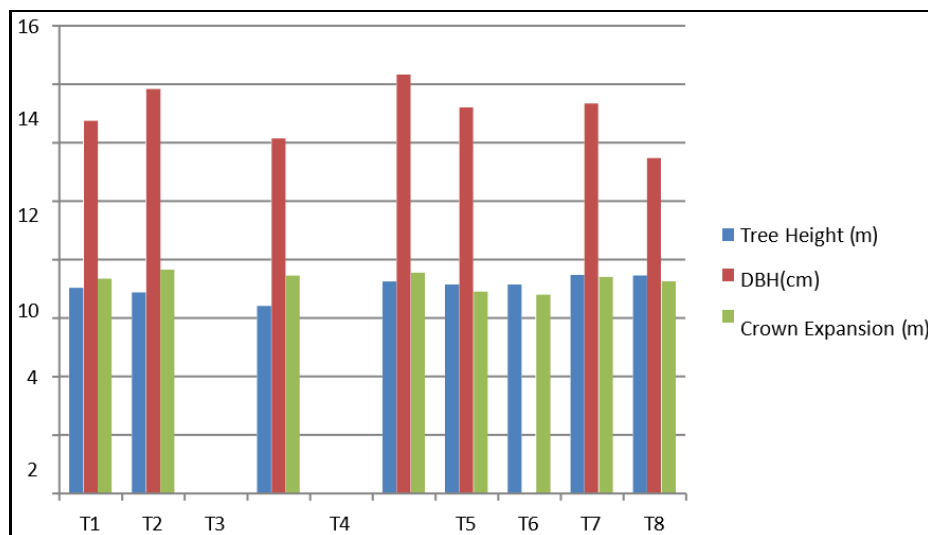


Fig 1: Mean growth performance of Karanj (*Pongamia pinnata*) in agroforestry system

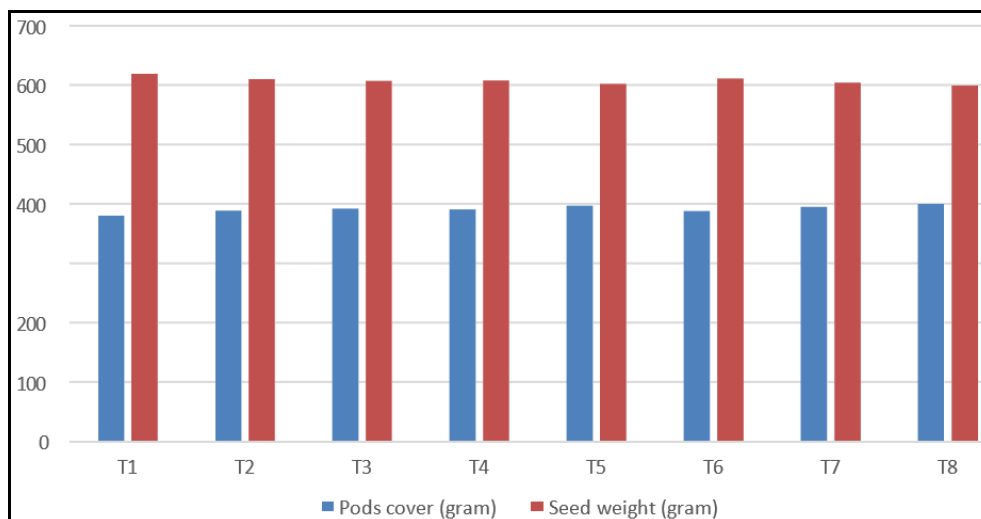
2. Seed/Cover Ratio of karanj (*Pongamia pinnata*) in agroforestry system

The pod cover and seed weight was recorded and are presented below in Table 1 & Fig. 1. The pod cover was

ranging from 380 to 400 g with the grand mean of 391.50g. Highest was recorded in control. The seed weight was ranging from 600 to 620 g. The highest was recorded with the treatment T₁. The seed cover ratio observed was 3:02.

Table 2: Seed/Cover Ratio of karanj (*Pongamia pinnata*) in agroforestry system

Treatment	Pods cover (gram)	Seed weight (gram)	Seed/Cover
T ₁	380	620	3:02
T ₂	389	611	3:02
T ₃	392	608	3:02
T ₄	391	609	3:02
T ₅	397	603	3:02
T ₆	388	612	3:02
T ₇	395	605	3:02
T ₈	400	600	3:02
Mean	391.50	608.50	

**Fig 2:** Seed/Cover Ratio of karanj in agroforestry system

3. Yield attributes of Karanj (*Pongamia pinnata*) in agroforestry system

The yield attributes of Karanj intercropped with Patchouli are presented in the Table 2, Fig 2 & 3. The total pod weight was recorded significantly higher with the treatment 2 (4.52 g) and was least with the control (2.14 g) and the grand mean of 3.20g was recorded among different treatments. The pod cover weight recorded significantly highest with the treatment 2 (2 g) and was least with control (1.28 g), with the grand mean of 1.62 g. The pod cover length among different treatment was found to be non-significant and was ranging from 4.13 to

5.16 cm. The seed weight was significantly higher with the treatment 7 (2.40 cm) and was least with the treatment 3 (0.82 cm) with the grand mean of 1.36 cm. The seed width was significantly higher with the treatment 3 (2.27 cm) and treatment 6 (2.27 cm). The least seed length was recorded with control (1.88 cm). The total seed weight was significantly higher with the treatment 2 (1.67 cm) and the least seed width was recorded with control (1.25 cm). The oil content extracted from Karanj recorded significantly higher with the treatment 4 (319.00 kg/ml) and the least was recorded with control (242.67 kg/ml) with the grand mean of 273.21 kg/ml.

Table 3: Yield attributes of Karanj (*Pongamia pinnata*) in agroforestry system

Treatment	Total weight of pod (g)	Pods Cover Weight (g)	Pods Cover Length (cm)	Pods Cover Width (cm)	Seed weight (g)	Seed Length (cm)	Seed Width (cm)	Oil Content Karanj/Kg (ml)
T ₁	4.10	1.88	4.82	2.29	1.85	1.93	1.51	241.67
T ₂	4.52**	2.00**	5.16	2.35	1.84	2.05	1.67**	279.00
T ₃	3.11	1.68	4.48	2.22	1.37	2.27**	1.49	281.00
T ₄	2.15	1.29	4.21	1.84	0.82	1.91	1.34	319.00**
T ₅	2.53	1.53	3.91	2.03	0.98	1.96	1.36	260.00
T ₆	2.94	1.44	5.02	2.08	1.31	2.27**	1.50	280.00
T ₇	4.13	1.89	4.95	2.40**	1.87**	2.05	1.55	282.33
T ₈	2.14	1.28	4.13	1.74	0.81	1.88	1.25	242.67
Mean	3.20	1.62	4.59	2.12	1.36	2.04	1.46	273.21
CV	0.386	0.126		0.141	0.493	0.200	1.325	0.838
CD @ 1%	0.030	0.005	NS	0.007	0.016	0.010	0.047	5.566
CD @ 5%	0.022	0.004		0.005	0.012	0.007	0.034	4.011

**Significant @ 5%; NS: Non Significant

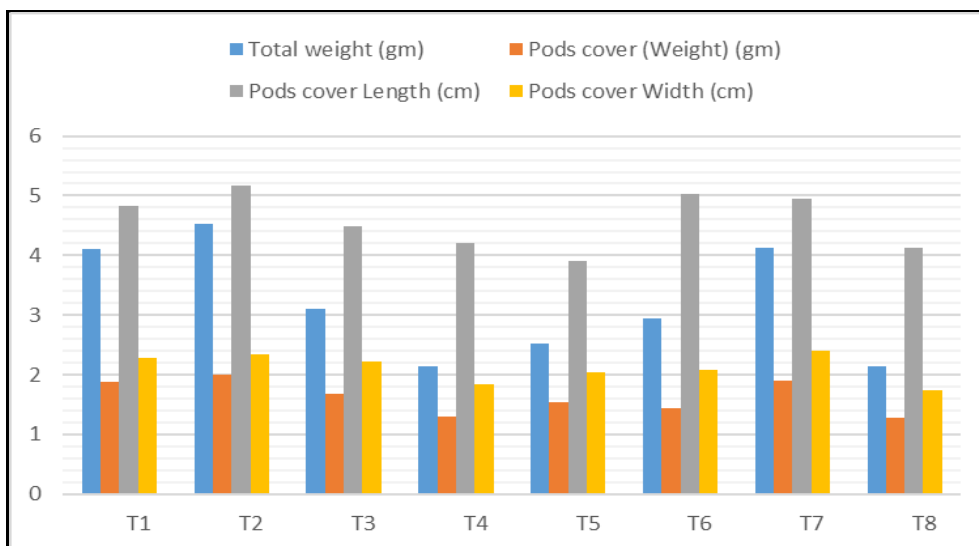


Fig 3: Total pod cover, pod weight, pod cover length and width of Karanj (*Pongamia pinnat*) inter cropped with Patchouli

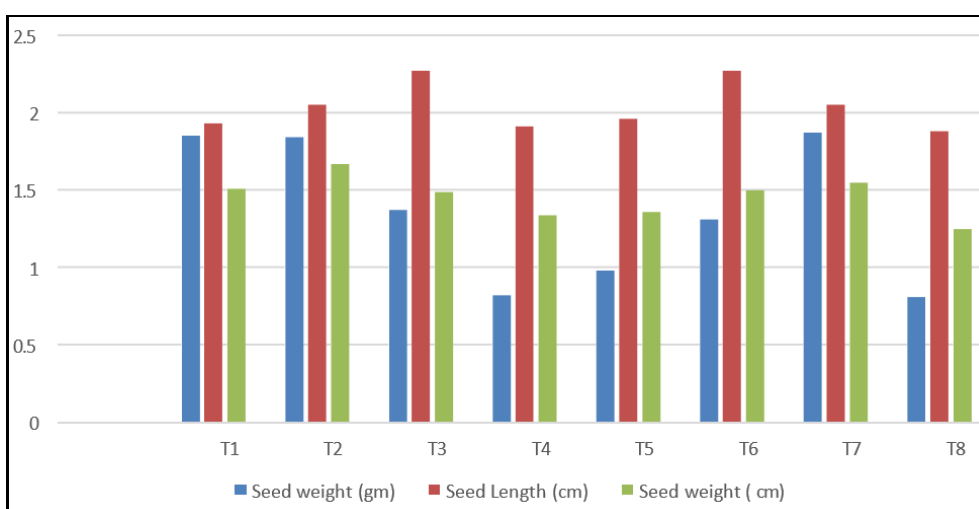


Fig 4: Seed weight, seed length and seed width of Karanj (*Pongamia pinnata*) inter cropped with Patchouli

Correlation matrix

The pod cover weight is significantly associated with seed width. Pod cover length is significantly associated with pod cover with, seed weight and seed width. Pod cover width

was significantly associated with seed width and seed weight and seed weight is significantly associated with seed width. The correlation matrix is presented in the Table 4.

Table 4: Correlation matrix of growth parameter and yield performance of Karanj in agroforestry system

	Tree height	DBH	Crown expansion	Pods cover (gram)	Total Weight (gm)	Pods Cover Weight (gm)	Pod Cover length	Pods Cover width	Seed Weight (gm)	Seed Length (cm)	Seed Width (cm)	Oil Content Karanj/Kg (ml)
var1	1	0.106	-0.236	0.361	-0.23	-0.332	-0.146	-0.362	-0.227	-0.59	-0.412	-0.094
var2	0.106	1	-0.256	-0.361	0.09	-0.034	0.43	0.124	0.096	0.335	0.352	0.599
var3	-0.236	-0.256	1	-0.156	0.393	0.41	0.219	0.271	0.326	-0.228	0.319	0.329
var4	0.361	-0.361	-0.156	1	-0.536	-0.458	-0.588	-0.478	-0.574	-0.173	-0.551	0.005
var5	-0.23	0.09	0.393	-0.536	1	0.972	0.827	0.936	0.984	0.2	0.918	-0.131
var6	-0.332	-0.034	0.41	-0.458	0.972	1	0.689	0.954	0.949	0.18	0.879**	-0.158
var7	-0.146	0.43	0.219	-0.588	0.827	0.689	1	0.747**	0.844**	0.466	0.886**	0.086
var8	-0.362	0.124	0.271	-0.478	0.936	0.954	0.747	1	0.953**	0.403	0.915**	-0.024
var9	-0.227	0.096	0.326	-0.574	0.984	0.949	0.844	0.953	1	0.273	0.902**	-0.139
var10	-0.59	0.335	-0.228	-0.173	0.2	0.18	0.466	0.403	0.273	1	0.489	0.256
var11	-0.412	0.352	0.319	-0.551	0.918	0.879	0.886	0.915	0.902	0.489	1	0.136
var12	-0.094	0.599	0.329	0.005	-0.131	-0.158	0.086	-0.024	-0.139	0.256	0.136	1

**Significant @ 5%

Conclusion

The growth performance of Karanj tree was recorded which reveals that the tree height of Karanj and crown expansion

recorded non-significant among different treatments. The tree diameter at breast height (DBH) recorded significantly higher with the treatment 6. The seed cover ratio was in the

ratio of 3:02, higher pod cover was recorded in control and higher seed weight was recorded with the treatment 1. The yield attributes of karanj also revealed that treatment 2 recorded significantly higher pod weight, pod cover weight, and seed width. Higher seed length was recorded with the treatment 2. Higher oil content in karanj recorded with the treatment 4. Seed weight was significantly higher with the treatment 6 and significantly higher pod cover width and seed weight with the treatment 7.

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