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Effect of PGR on Yield of Patchouli (*Pogostemon cablin*) Under Karanj (*Pongamia pinnata*) Based Agro-forestry System

Mohit Anand Sandiman[1]*, Pratap Toppo[1], Himanshu[1], Pankaj[1], Dayanand Sai Painkra[1], Manish Kumar[1], Shristy Hakre[1], Mausami Tiwari[1] and Shani Raj[2]

[1]*Department of Forestry, College of Agriculture, Raipur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India*
[2]*Depatment of Horticulture, BTC College of agriculture and research station, Bilaspur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India*

**Corresponding author*

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A B S T R A C T

A field experiment was conducted at the Herbal Garden of Department of Forestry, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). During the year 2021-22 with a view to study the "Effect of PGR on Yield of Patchouli (*Pogostemon cablin*) Under Karanj (*Pongamia pinnata*) Based Agro-forestry System". The Patchouli intercrops under Karanj tree crop were used to grown and treatment was replicated three times in randomized block design (RBD). The soil of experimental field was clay to loam soil. The investigation, There were three growth regulators and chemicals(NAA, Miraculan and GA) were used, which were applied at different concentrations in Patchouli in eight treatments *viz*., T_1: - Control (Basal Dose) (150:50:50 kg NPK ha^{-1}), T_2: - Basal Dose + NAA @ 20ppm, T_3:- Basal Dose + NAA @ 25ppm, T_4:- Basal Dose + NAA @ 30ppm, T_5:- Basal Dose + miraculan @ 100ppm, T_6:- Basal Dose + miraculan @ 150ppm, T_7: - Basal Dose + GA @ 20 ppm and T_8:- Basal Dose + GA @ 30ppm.The yield parameters *i.e.*, fresh herbage yields (q ha^{-1}), Dry herbage yield (q ha^{-1}) and oil yield (kg ha^{-1}) were significantly superior in the treatment T_7 (GA @ 20 ppm). On the basis of above findings, treatment T_7 (GA @ 20 ppm) stand could be better performance first in position and T_8 (GA @ 30ppm) stand in second order of preference. However, treatment T_3 (NAA @ 25ppm) comes in next in order. Therefore, it may be concluded that treatment T_7 (GA @ 20 ppm) may be prefer for higher yield in patchouli.

Introduction

Amongst the aromatic plants, patchouli (*Pogostemon cablin* Benth.) is one of the important tropical, perennial, bushy herbaceous plants belonging to the family Lamiaceae. It was originated from Philippines and now is cultivated in countries like China, Indonesia, Malaysia, Thailand, Mauritius, West Africa, Vietnam and India.

The plant was first outlined by botanist Pelletier-Sauteletin 1845 and tagged it as *Pogostemon* *patchouli*. 'Patchouli' plant was first time introduced to India in 1834 in the Royal Botanic Garden, Calcutta (Anon, 1888).

Over time, continued exploitation of many medicinal plant species, as well as significant habitat loss, has resulted in the population depletion of many high-value medicinal plant species. Karanj is also advertised as having the ability to produce oil on poor, degraded, or saline soils (Murphy *et al.*, 2012; Banful *et al*., 2017; Dewangan *et al*., 2020).

In India, karanj trees have been used for soil reclamation and re-vegetation around coal mines (Maiti, 2012). In India, villagers have historically used karanj to tie the soil on sloping uplands (Kumar, 2004; Barman, *et al*., 2015; Darunde and Pandey, 2019).

Many farmers do not use synthetic pesticides, and some consumers will only buy organic produce. Many plant species produce substances that protect them by killing or repelling the insects that feed on them (Pelegrini *et al.*, 2006; Heliken *et al*., 2020; Halimursyadah *et al*., 2021).

The use of medicinal plants in traditional medicine has been described in literature dating back several 1000 years (Khan *et al*., 2015; Chang *et al.*, 2016).

Books on Ayurvedic medicine, written in the Vedic period (3500–1600 B.C.) describe practices, including the use of medicinal plants, that formed the basis of all other medical sciences developed on the Indian subcontinent (Pattanayak *et al*., 2010).

In modern complementary and alternative medical practice, plants are the primary source of therapeutics and each part of the plant, including the seeds, root, stem, leaves, and fruit, potentially contains bioactive components (Mandave *et al*., 2014; Maulia *et al*., 2021; Nihayati *et al*., 2021).

Materials and Methods

The field experiment was conducted at the Herbal Garden of Department of Forestry, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Raipur is situated in mid-eastern part of Chhattisgarh at a latitude of 21^{o}16'N, longitude of 81^{o}36'E and at an altitude of 289.56 meters above the mean sea level. On the basis of prevailing climatic conditions, Raipur is characterized as slightly moist and sub-humid zone where the average annual rainfall received ranges from 1200 to 1400 mm.

The soil of experimental field was clay to loam soil. The collected sample was mixed thoroughly and composite sample was analyzed to determine physic-chemical composition of soil.

There were three growth regulators and chemicals were used. NAA, Growth promoter, stimulates cell division, cell elongation and elongation of shoot, photosynthesis, RNA synthesis, membrane permeability to water uptake, prevents abscission of to leaves, enhance leaf area index leaf chlorophyll content in crop plants.

Miraculan, Growth promoter, stimulates cell division, cell elongation, auxin metabolism, cell wall plasticity and permeability of cell membranes, RNA synthesis, induction of hydrolytic enzymes and increases plant height, increased mobilization and translocation of reserve food material.

GA, Growth promoter has been found in increase the crop yield in enhancement in mobilization of photosynthetic activity and rapid increase in reducing sugars, soluble protein, succinate and changes in permeability of membrane. The observations were observed for randomly selected five plants from each plot and were tagged for recording various observations at different stages.

Results and Discussion

Data pertaining to yield attributes influenced by various treatments has been given in table 1.1and fig 1.1, 1.2 & 1.3.

The present study clearly reveals that, the fresh herbage yield (q ha^{-1}) at 1^{st} harvest was recorded significant maximum (55.78) in treatment T_7 (GA @ 20 ppm), however, the fresh herbage yield (q ha^{-1}) was observed minimum in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (47.31).

Similarly, at 2^{nd} harvest the fresh herbage yield (q ha^{-1}) was recorded significant maximum (54.87) in treatment T_4 (NAA @ 30ppm), while significantly minimum fresh herbage yield (q ha^{-1}) was observed in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (46.06).

The total fresh herbage yield (q ha^{-1}) was recorded significant maximum (110.07) in treatment T_7 (GA @ 20 ppm), while significantly minimum fresh herbage yield (q ha^{-1}) was observed in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (93.37).

Mousa and Emary (1983) showed that the effect of foliar applied GA on sweet basil in which GA considerably reduced plant height but increased herbage yield.

The dry herbage yield (q ha^{-1}) at 1^{st} harvest was recorded significant maximum (16.85) in treatment T_7 (GA @ 20 ppm), while significantly minimum dry herbage yield (q ha^{-1}) was observed in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (11.27).

Similarly, at 2^{nd} harvest the dry herbage yield (q ha^{-1}) was recorded significant maximum (15.91) in treatment T_7 (GA @ 20 ppm), while significantly minimum dry herbage yield (q ha^{-1}) was observed in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (10.33).The total dry herbage yield (q ha^{-1}) was recorded significant maximum (32.76) in treatment T_7 (GA @ 20 ppm), while significantly minimum dry herbage yield (q ha^{-1}) was observed in treatment T_1 (Control (RDF 150:50:50 kg NPK ha^{-1}) of (21.61).

Mousa and Emary (1983) showed that the effect of foliar applied GA on sweet basil in which GA considerably reduced plant height but increased herbage yield.

The present study clearly reveals that, the oil yield (kg ha^{-1}) at 1^{st} harvest was recorded significant maximum (36.49) in treatment T_7 (GA @ 20 ppm), however, the plants bear minimum oil yield (kg ha^{-1}) was observed in treatment T_6 (Miraculan @ 150ppm) of (24.18).

Similarly, at 2^{nd} harvest the oil yield (kg ha^{-1}) was recorded significant maximum (36.55) in treatment T_7 (GA @ 20 ppm), while significantly minimum oil yield (kg ha^{-1}) was observed in treatment T_6 (Miraculan @ 150ppm) of (24.02).

The total oil yield (kg ha^{-1}) was recorded significant maximum (73.04) in treatment T_7 (GA @ 20 ppm), however, the plants bear minimum oil yield (kg ha^{-1}) was observed in treatment T_6 (Miraculan @ 150ppm) of (48.20).

The same trend also reported by Asangi *et al.,* (2013) studied that, the effect of growth regulators on plant growth, herbage yield, essential oil content and oil yield in patchouli (*Pogostemon patchouli* Pellet.) variety Cim-shreshta.

The yield Parameters like fresh herbage yield (q ha^{-1}), dry herbage yield (q ha^{-1}) and oil yield (kg ha^{-1}) were significantly superior in the treatment T_7 (Basal Dose + GA @ 20 ppm) and similar trend find with treatment T8 (Basal Dose + GA @ 30ppm), T_4 (Basal Dose + NAA @ 30ppm) and T_3 (Basal Dose + NAA @ 25ppm) was proved to be potent PGR to enhance the different physiological, morpho-physiological and structural components of patchouli and increasing the yield potential in the form of herbage.

On the basis of present investigation treatment T_7 (Basal Dose + GA @ 20 ppm) stand could be better performance first in position and T_8 (Basal Dose + GA @ 30ppm) stand in second order of preference, it may be concluded that treatmentT_7 (Basal Dose + GA @ 20 ppm) was found significantly superior for all the growth and yield parameters.

Table.1 Impact of plant growth regulators on Yield parameters of patchouli (*Pogostemon cablin*) under karanj (*Pongamia pinnata*) based agroforestry system

Tr. No.	Treatments	Fresh Herbage Yield(q ha^{-1})			Dry Herbage Yield(q ha^{-1})		
		1st harvest	2nd harvest	TOTAL	1st harvest	2nd harvest	TOTAL
T_1	**Control (RDF 150:50:50 kg NPK ha^{-1})**	47.31	46.06	93.37	11.27	10.33	21.61
T_2	**NAA @ 20ppm**	52.87	50.33	103.21	13.34	12.87	26.21
T_3	**NAA @ 25ppm**	53.28	54.37	107.65	11.89	15.44	27.33
T_4	**NAA @ 30ppm**	53.21	54.87	108.08	13.09	13.12	26.21
T_5	**Miraculan @ 100ppm**	44.08	51.03	95.11	11.66	13.92	25.58
T_6	**Miraculan @ 150ppm**	48.45	45.79	94.24	12.77	12.19	24.96
T_7	**GA @ 20 ppm**	55.78	54.29	110.07	16.85	15.91	32.76
T_8	**GA @ 30ppm**	54.79	53.64	108.43	15.95	14.91	30.86
SEm (±)		**2.00**	**1.72**	**3.91**	**1.15**	**0.99**	**1.22**
CD @ (P=0.05)		**6.07**	**5.21**	**11.86**	**3.50**	**3.01**	**3.69**

Conti...

Tr. No.	Treatments	Oil Yield (kg ha^{-1})		
		1st harvest	2nd harvest	TOTAL
T_1	Control (RDF 150:50:50 kg NPK ha^{-1})	27.60	25.11	52.71
T_2	NAA @ 20ppm	33.51	33.44	66.95
T_3	NAA @ 25ppm	35.36	34.83	70.19
T_4	NAA @ 30ppm	35.05	35.77	71.82
T_5	Miraculan @ 100ppm	26.23	27.56	53.79
T_6	Miraculan @ 150ppm	24.18	24.02	48.20
T_7	GA @ 20 ppm	36.49	36.55	73.04
T_8	GA @ 30ppm	36.17	35.06	71.23
SEm (±)		**1.30**	**1.39**	**2.07**
CD @ (P=0.05)		**3.95**	**4.24**	**6.29**

Fig.1 Fresh Herbage Yield (q ha^{-1})

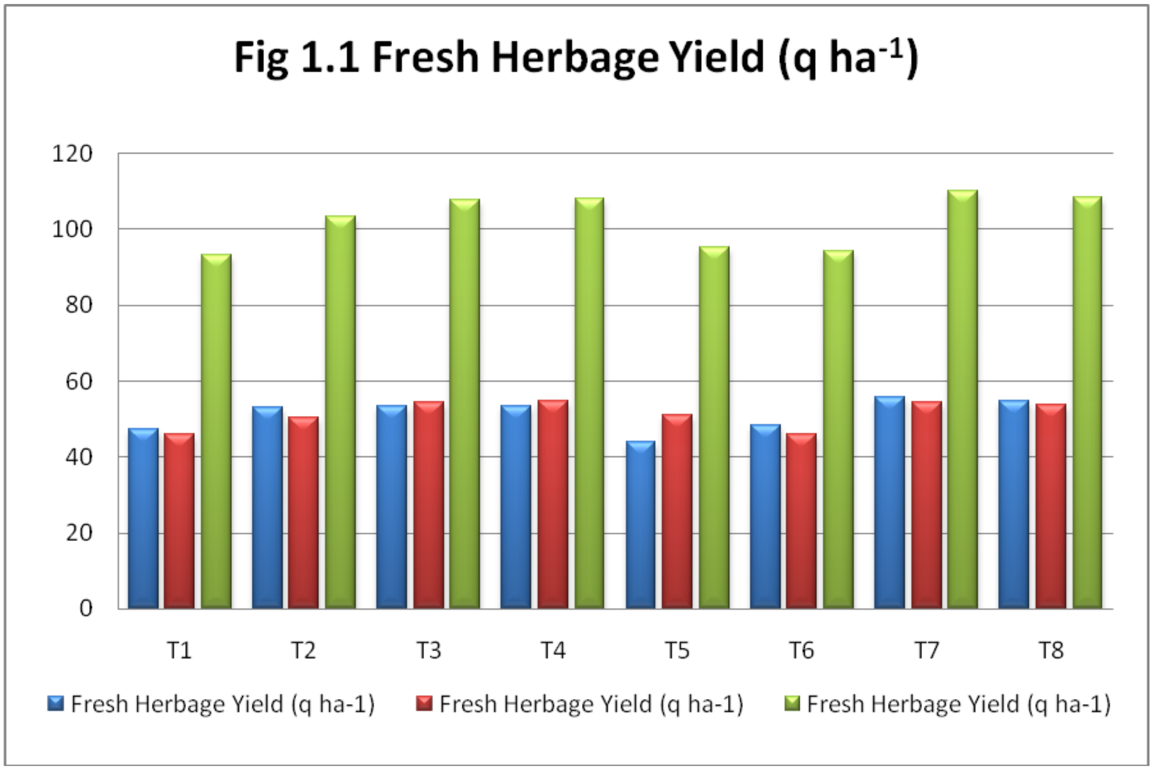

Fig.2 Dry Herbage Yield (q ha^{-1})

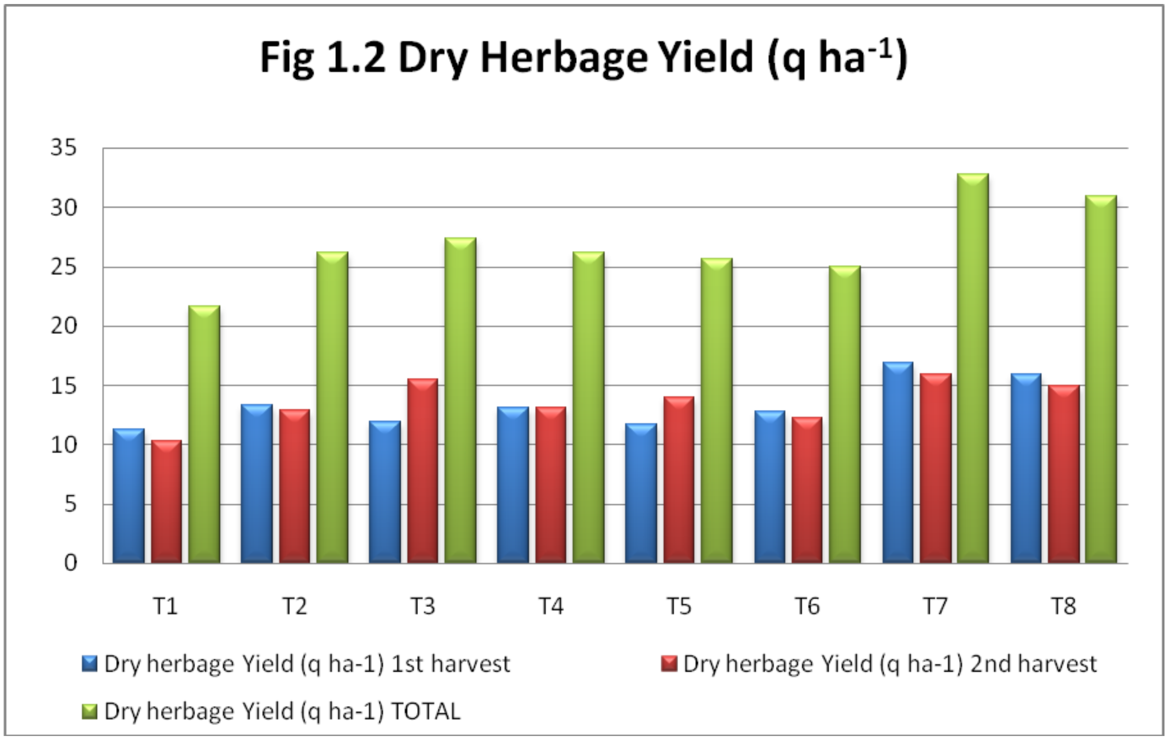

Fig.3 Oil Yield (kg ha^{-1})

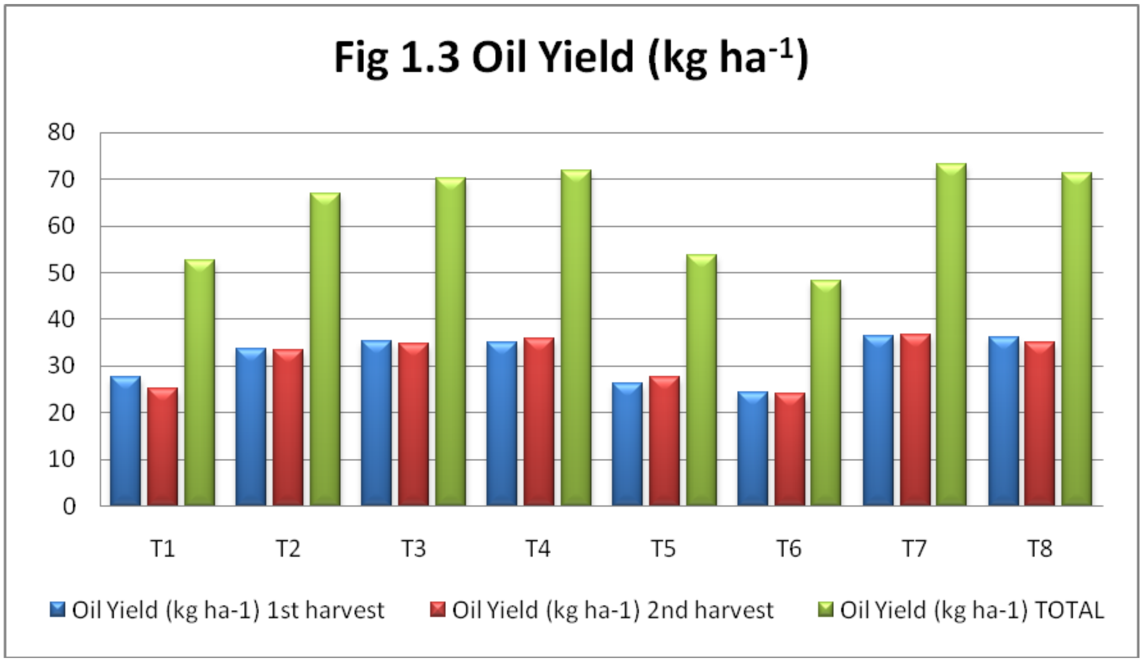

Plate.1 View of experiment field

Plate.2 Crop observation

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