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PERFORMANCE OF MEDICINAL HERBS IN TREE BASED CROPPING SYSTEM UNDER DRYLAND CONDITIONS

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Abstract- The field experiment was conducted in Alfisols at AICRP on Agroforestry, ANGRAU, Rajendranagar, Hyderabad during kharif season of 2008-09 and 2009-10. The present investigation comprised of two agroforestry models i.e., aswagandha and andrographis intercropped agri-horticultural systems laid out separately in split plot design with three replications in four year old amla and terminalia plantations. The treatments in aswagandha based agri-horticultural system consisted of three cropping situations as main plots viz., intercropping of aswagandha in amla, intercropping of aswagandha in terminalia and sole cropping of aswagandha while in andrographis based agri-horticultural system, the treatments included three cropping situations as main plots viz., intercropping in amla, terminalia and sole cropping of andrographis.

The results indicated that among the different cropping situations studied in aswagandha based agri-horticultural system, growth parameters like plant height, dry matter production and leaf area per plant of aswagandha were markedly higher under sole cropping situation when compared to intercropping situation both in amla and terminalia. Days to physiological maturity of aswagandha was delayed by 9-10 days in intercropping situation in terminalia when compared to intercropping in amla. Root and seed yields (kg ha-1) of aswagandha were the highest with sole cropping situation compared to either of the intercropping situations. Aswagandha performed better to some extent as an intercrop in amla as compared in terminalia. Withanolide content (%) was significantly more under sole cropping. PAR was more under sole cropping compared to intercropping situation.

Andrographis intercropped agri-horti system revealed that growth parameters of andrographis i.e., plant height, dry matter production and leaf area per plant were found maximum in sole cropping of andrographis followed by intercropping in amla and terminalia. Days to 50% flowering and physiological maturity were delayed by 3-4 days under intercropping situation over sole cropping. Herbage yield (kg ha-1) of andrographis and andrographolide content (%) were the highest in sole cropping of andrographis compared to intercropping situations. The total gross and net monetary returns from the system (tree + crop) were the highest with andrographis intercropped in terminalia when compared to sole cropping of andrographis.

Keywords- *Andrographis paniculata*, Aswagandha, Agri-horticulture, Intercropping.

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Introduction

Agri-horticultural system with dryland fruit trees as basic component is readily acceptable as an alternate land use, which provides stability and sustainability to resource poor farmers in semi arid tropics. The medicinal plants are the gifts of nature for the well being of mankind and now-a-days the whole world is shifting from the use of synthetic drugs to the use of natural drugs. India is the 3rd richest country in the world in the number of plant species, having 15000 medicinal plant species and about 2,000 species are used in Indian system of medicine. About 25 per cent of the drugs in modern pharmacopoeia are derived from plants.

Several approaches are feasible, integrating shade tolerant MAPs as lower strata species in multistrata systems, cultivating short cycle MAPs as intercrops in existing stands of plantation tree-crops and new forest plantations. The number of years MAPs can be intercropped with a given tree species depends on the size and

intensity of its canopy shade, tree spacing and management, especially pruning of branches and the nature of the MAPs. Shade-tolerant and rhizomatic MAPs can be grown on a long-term basis in widely spaced plantations [8]. Kalmegh and Aswagandha are such medicinal plants which can be grown under shade, intercropped with tree species.

Keeping in view the importance of agri-horticultural systems, comprehensive studies on production potential of model agri-horticultural systems including amla and terminalia as tree species with kalmegh and aswagandha as intercrops in drylands was studied.

Material and methods

The treatments comprised of three cropping situations (CS) - (i) Intercropping aswagandha in amla based cropping system (C1), (ii) Intercropping aswagandha in terminalia based cropping system (C2), (iii) Sole cropping of aswagandha (C3) as main plots. Similarly three cropping situations with andrographis i.e., (i) Intercropping andrographis in amla based cropping system (C1), (ii) Intercropping andrographis in terminalia based cropping system (C2) and (iii) Sole cropping of andrographis (C3) were studied. The tree species namely amla (*Emblica officinalis*), variety - Narendra 7 and improved lines of local variety of terminalia (*Terminalia chebula*) were planted in the year 2004 at 3.6 m x 3.6 m spacing. The tree planted area was divided into plots of 7.2 m x 3.6 m consisting of two rows with 3 trees accommodating 12 rows of andrographis and 12 rows of aswagandha with a spacing of 30 cm x 15 cm in andrographis and 30 x 10 cm in aswagandha. Nagori variety of aswagandha and local variety of andrographis were sown in the plots.

Harvesting of aswagandha was done by uprooting the plants, roots were dried and root yield was calculated for respective treatmental plots. The herbage yield of andrographis from above ground parts of the plant excluding the roots was recorded and expressed in kg ha-1. The andrographolide content of dried leaves and shoots was estimated at each harvest as per the procedure outlined by Srivastava, et al. (1959) and expressed on dry weight basis in per cent. Andrographolide content was estimated at first cut (flower initiation) and harvest stage. The withanolide content of dried roots of aswagandha from each treatment was estimated by following the procedure and expressed in percent [10].

Result and Discussions

Aswangandha

Fig. 1-Aswangandha

Dry matter production

Sole cropping of aswagandha recorded significantly more dry matter than dry matter produced by intercropped aswagandha. Among, the two intercropping systems, C1 recorded significantly more dry matter over C2 at all the stages during both the years. Maximum dry matter of 776.4 g m-2 and 755.9 g m-2 were recorded by C3 in first and second year respectively whereas the lowest dry matter production was found with C2 i.e., 304.1 and 279.7 g m -2 during first and second year respectively (Table 1). The decrease in plant height due to its intercropping in the tree plantations has resulted in reduction of dry matter production. The present results signify the importance of solar radiation for better performance of medicinal herb like aswagandha. The data recorded on PAR (Photo-synthetically active radiation) also clearly indicated that the influence of shade offered by the tree plantations caused greater reduction in PAR values [7].

Table 1- Dry matter (gm-2), root yield (kg ha-1), seed yield (kg ha-1) and withanolide content (%) of aswagandha as influenced by different cropping situations during 2008-09 & 2009-10

Treatments	Dry matter (g m^{-2})		Root yield (kg ha^{-1})		Seed yield (kg ha^{-1})		Withanolide (%)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Cropping situation (CS)								
C_1-Aswagnadha intercopping in Amla	669.9	606.1	283.4	274.2	35.4	29.7	0.32	0.25
C_2 - Aswagandha intercropping in Terminalia	304.1	279.7	113.6	106.9	22.8	17.8	0.24	0.19
C_3 - Sole cropping of Aswagandha	776.4	755.9	442.5	410.4	50.3	46.2	0.43	0.38
SEm+	5.99	5	2.96	3.33	0.47	0.77	0.01	0.02
CD (P=0.05)	16.65	13.99	8.22	9.24	1.31	2.14	0.03	0.05

Root yield

Root yield of aswagandha is important for its economic value and also possess medicinal property. Sole cropping of aswagandha produced significantly higher root yield (442.5 and 410.4 kg ha-1) over both the intercropping systems. Between the intercropping systems, C1 produced significantly higher root yield (283.4 and 274.2 kg ha-1 in first and second years respectively) in both years over C2 with 113.6 and 106.9 kg ha-1 root yield in first and second year respectively. Sole crop of aswagandha recorded 328.9 and 303.5 kg ha-1 of root yield more in first and second year respectively over C2 (Table 1). Similarly, C1 recorded 169.8 and 167.3 kg ha-1 more yield over C2. The maximum root yield of aswagandha under sole cropping situation was due to its optimum growth in terms of plant height, dry matter production and leaf area per plant, whereas, the reduced plant productivity of intercropped aswagandha in terms of root yield was due to reduced plant growth which was mainly due to shading. The present result infer that aswagandha could be grown as an intercrop in sparsely shaded tree plantations like amla rather than densely shaded terminalia [13,14].

Seed yield

Sole crop of aswagandha gave the highest seed yield of 50.3 and 46.2 kg ha-1 in first and second year respectively which was found significantly more recorded by either of the two intercropping systems i.e., C1 and C2. The increase in seed yield by sole cropping over C1 and C2 were 42.0 and 121.0 per cent in first year and 55.6 and 159.6 per cent in second year respectively (Table 1).

Withanolide content

The withanolide content is the principle drug component of aswagandha. Sole cropping system recorded the maximum withanolide content (0.43%) followed by intercropping system of C1

(0.32%) which were significantly superior to the other intercropping system i.e., C2 during first year of study. There was an improvement of 79.2 and 100% of withanolide due to sole cropping over C2 in first and second year respectively (Table 1). It is inferred from the results that the withanolide content of the roots was influenced by the intensity of shade offered by amla and terminalia plantations wherein more shading was experienced by aswagandha under terminalia plantation.

The reduction in withanolide content of intercropped aswagandha was mainly attributed to low PAR experienced under terminalia leading to less accumulation of assimilates in the root, followed by amla plantation [1,5].

Economics

Among the three cropping situations, sole cropping of aswagandha gave maximum gross and net returns followed by intercropping in amla and terminalia. It could be attributed to better performance of crop growth resulting in an improvement of root yield in aswagandha in sole cropping than intercropping which might have affected with competition by trees.

Table 2- Total gross and net monetary returns (Rs ha-1) from the system (tree+crop) in aswagandha under different cropping situations during 2008-09 and 2009-2010

Treatments	2008-09			2009-10		
Cropping situations (CS)	Total Gross monetary returns	Total Net monetary returns	Profit per rupee investment	Total Gross monetary returns	Total Net monetary returns	Profit per rupee investment
Intercropping in amla	53494	27911	1.6	52342	24404	0.85
Intercropping in terminalia	270767	245184	9.45	266400	238462	8.41
Sole crop	45260	23177	1.07	41959	17522	0.73

Terminalia+aswagandha system proved beneficial than amla+aswagandha with highest profit per rupee investment (Table 2) [4,13,14]. The main advantage of higher output cost of terminalia contributed for higher net returns, although the performance of aswagandha was poor under terminalia plantation with dense shading. The same aswagandha could perform better under amla plantation because of sparse shading offered by amla trees. But, due to less output cost of amla, the total returns were lower over amla aswagandha system.

Andrographis

Fig. 2- Andrographis

Dry matter production

Maximum dry matter production was registered in sole cropping. The increase in dry matter due to C3 (sole cropping of andrographis) over C2 (intercropping andrographis in terminalia) in first year and second year at 105 DAS was 37.1 and 35.3 per cent respectively. While comparing the two intercropping systems, the cropping system C1 proved significantly superior to C2 in terms of dry matter production. There was an increase of 18.4 and 18.2 per cent in dry matter due to C3 over C2 at final harvesting in first and second year respectively (Table 3).Dry matter production in sole cropping was maximum due to better availability of natural resources like light, water and nutrients compared to intercropped situation. Andrographis intercropped under amla gave higher dry matter production when compared to terminalia. But the decrease was to a lesser extent [11]. [*See Table-3 at the end of the article*]

Herbage yield

The sole cropping system of andrographis recorded the highest herbage yield at first cut (2515.4 and 2451.1 kg ha-1) and second cut (2683.9 and 2591.5 kg ha-1) in both the years of study and proved significantly superior to intercropping systems i.e., C1 and C2 at second cutting but stood at par with C1 at first cutting during first year. Sole cropping proved superior to both the intercropping systems at both the cuttings during second year. C3 recorded an increased yield of 31.7 and 113.2 kg ha-1 at first and second cutting in first year over C2 respectively. Similarly, in second year, C3 resulted in herbage yield increase over C2 to an extent of 18.3 and 55.7 kg ha-1 [*See Table-3 at the end of the article*].

Herbage yields of andrographis obtained from two cuts under sole cropping was higher over the other two cropping situations. This might be due to non intervention of the tree component in respect to availability of light, water and nutrients. Andrographis under amla recorded high herbage yield over terminalia due to maximum light interception resulting in better crop growth [6].

Andrographolide content

Maximum andrographolide content was recorded by sole crop (2.47 and 2.34%) followed by intercropping system of C1 (2.37 and 2.28%) and C2 (2.19 and 2.12%) at first cutting in both the years (Table 3). Andrographolide content in andrographis under sole crop was maximum followed by intercropping in amla and terminalia due to better availability of nutrients leading to accumulation of photosynthates, thus manifesting higher andrographolide content. Between the two cropping systems, andrographolide content was less in andrographis under terminalia due to less crop growth under dense shading [9,11].

Fig. 3- Aswagandha intercropped in amla

Fig. 4-Aswagandha intercropped in terminalia

Fig. 5- Andrographis intercropped in amla

Fig. 6- Andrographis intercropped in terminalia

Economics

The gross and net returns were the highest with terminalia + andrographis intercropping system. There was about three times more profit per rupee investment due to terminalia + andrographis over amla + andrographis cropping system (Table 4). These improved returns from the agri-horticultural systems [2,3,15].

Table 4-Total gross and net monetary returns (Rs ha-1) from the system (tree+crop) in andrographis under different cropping situations during 2008-09 and 2009-20

Treatments	2008-09			2009-10		
	Total Gross monetary returns	Total Net monetary returns	Profit per rupee investment	Total Gross monetary returns	Total Net monetary returns	Profit per rupee investment
Cropping situations (CS)						
Intercropping in amla	93731	66897	2.47	88523	59310	2.01
Intercropping in terminalia	328338	301505	11.11	321279	292066	9.89
Sole crop	66291	42957	1.86	60511	34799	1.37

References

[1] Antony Joseph Raj, Lal S.B., Sameer Daniel and Vitala Gowda. (2010) *Indian Journal of Agroforestry*, 12(1), 13-17.

[2] CRIDA (2000) *Annual Report for the period,* 45-47.

[3] CRIDA (2001) *Annual Report for the period,* 45-47.

[4] Ghosh D.K., Bandopadhyay A., Maji M.K. and Mahapatra S. (2007) *West Bengal Indian Coconut Journal*, 38(8), 15-18.

[5] Kamla Singh, Virendra Singh, Husain A. and Kothari S.K. (1990) *Indian Forester March*, 189-193.

[6] Jha K.K. and Chandra Gupta (1991) *Indian Forester*, 535-543.

[7] Pandey A.K and Mandal A.K. (2010*) Iranica Journal of Energy and Environment*, 1(2), 165-169.

[8] Rao M.R., Palada M.C and Becker B.N. (2004) *Agroforestry Systems*, 61, 107-122..

[9] Saravanan R., Sunil Krishti, Gajbhiye N.A. and Maiti S. (2008) *Indian Journal of Horticulture*, 65(2), 220-225.

[10] Seema P., Mishra U.S. and Agarwal V.K. (2008) *Laboratory manual on plant biochemical analysis*, 61.

[11] Srinivas N.N., Patil G.M. and Suresh Alagundagi (2008) *Karnataka Journal of Agricultural Science*, 21(4), 524-526.

[12] Srivastava S.K., Bose P.C., Ray G.K and Mukerji B. (1959) *Indian Journal of Pharmacy*, 21, 220-230.

[13] Sujatha S., Ravi Bhat., Balasimha D. and Kannan C. (2006*) Journal of Plantation Crops*, 34(3), 318-322.

[14] Sukhmal Chand, Rajeswara Rao B.R., Kaul P.N., Bhattacharya A.K., Singh K. and Singh C.P. (1998) *Indian Forester*, 566-568.

[15] Sunanda Rani N., Syed Ismail and Narayana Reddy Y. (2006) *Indian Journal of Dryland Agricultural Research and Development*, 21(2), 136-140.

Table 3-Dry matter ((g m-2), herbage yield (kg ha-1) and andrographolide content (%) of andrographis at first and second cut as influenced by different cropping situations during 2008-09 & 2009-10

Treatments	Dry matter production (g m^{-2})				Herbage yield (kg ha^{-1})				Andrographolide (%)			
	2008-09		2009-10		2008-09		2009-10		2008-09		2009-10	
	1st cut	2nd cut (final harvest)	1st cut	2nd cut (final harvest)	1st cut	2nd cut (final harvest)	1st cut	2nd cut (final harvest)	1st cut	2nd cut (final harvest)	1st cut	2nd cut (final harvest)
Cropping situation (CS)												
C_1-Andrographis intercropping in Amla	82.4	517	71.8	473.3	2485	2591.8	2415.5	2560.7	2.4	1.5	2.3	1.5
C_2-Andrographis intercropping in Terminalia	68.7	472.1	61.2	449.8	2483.7	2570.7	2432.8	2535.8	2.2	1.4	2.1	1.3
C_3 - Sole cropping of Andrographis	94.2	559	82.8	531.5	2515.4	2683.9	2451.1	2591.5	2.5	1.8	2.3	1.7
SEm+	1.56	4.57	1.69	6.89	16.02	11.42	3.72	10.8	0.02	0.03	0.02	0.01
CD (P=0.05)	4.34	12.69	4.68	19.13	44.48	31.7	10.34	29.99	0.05	0.08	0.05	0.04