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Influence of Canopy Pruning on Orange Growth and Rhizome Yield of Intercrop Ginger under Agri-Horticulture System.

Tasso Tabin[1,a*] • D. Balasubramanian[1,b] • A. Arunachalam[1,b]

[1]*Restoration Ecology Lab, Department of Forestry, North Eastern Regional Institute of Science & Technology, Nirjuli 791109, Arunachal Pradesh, India*

[a]*Present address: Krishi Vigyan Kendra, Geku (Korak) 791002, Upper Siang district, Arunachal Pradesh*

[b]*Present address: Indian Council of Agricultural Research, Krishi Bhawan, New Delhi 110001.*

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ABSTRACT

A field experiment was conducted during 2010-2011 at farmer orchard to determine the influence of canopy pruning on productivity of orange tree and intercrop (ginger) under rainfed conditions at Geku, Arunachal Pradesh. The growth parameter (dhb, height and canopy diameter) of orange tree was significantly ($P < 0.05$) higher in control than different canopy pruning intensities (50 % and 70 %) in both the year. However, the rate of growth, number of fruit/tree and kg/tree was significantly higher in pruned trees than control (unpruned). The growth and yield of intercrop was also significantly higher in trees pruned at different canopy intensities than control. Among canopy pruning intensities, 50 % canopy pruning intensity had higher rate of growth (5.7 %), number of fruit/tree (50 numbers) and kg/tree (1.13 kg) of orange while control (unpruned) had decline result with 1.7 %, 0.06 numbers of fruit/tree and 0.05 kg/tree respectively. However, the growth and rhizome yield of ginger was increase significantly at 70 % canopy pruning higher than 50 % canopy pruning and control. However, there was decline in growth and yield at 70 % canopy pruning and control (unpruned) in the next cropping season except, for 50 % canopy pruning which increase significantly with 38.66 cm, 3.78 numbers and 72.20 g/plant.

1. Introduction

The orange and ginger is the most important cash crop in Geku, Upper Siang district of Arunachal Pradesh, India. Ginger is intercropped under orange tree in agri-horticulture system. It is a sustainable land management system in which fruit tree is intercropped with spice crop. They compete inevitably for light, nutrients and other resources that affect the growth performance of the crop. The effect of tree on intercrop is not consistent and this effect may complimentary or competitive. The canopy tree provides shade and create conducive atmosphere for underneath crop to grow. Pruning of tree component is also a powerful approach to regulate this competition (Frank and Eduaro 2003).

However, as the functional balance of the tree is altered through pruning, it reacts both morphologically and physiologically in response to the change consequently, the growth and development of shoots and foliage may be altered. If sufficient recovery time is provided after pruning, such as reduction in growth gradually decreases and pruned tree resume their normal growth status. In agri-horticulture systems, presence of well-developed tree canopy and resultant shade make light an important factor in determining the potential of understory crops (Osman et al. 2007). Shoot pruning alleviates shading of crop an appeared as an effective means of increasing the light permeability and yield of intercrop (Newaj et al. 2007).

*Corresponding author: tabin7@gmail.com

Pruning also reduces the competitive ability of trees, which allow the top to take advantage of the higher nutrient availability under tree cropping system. Biomass yield and productivity of crop have also been reported higher under pruned tree (Dar and Newaj 2008). Keeping these points in view the present study was undertaken to find out the effect of different pruning intensity on tree growth and rhizome yield of intercrop.

2. Materials and methods

The experiment was conducted during 2010 to 2011 in farmer's orange orchard field at Geku, Arunachal Pradesh under rainfed conditions. The soil is well drained lateritic and red loamy type with several rocky patches. The orchard contained well established 10 year old mandarin trees planted with 4.5 m x 4.5 m. There were 3 levels of pruning intensity i.e. unpruned plant as control, 50 % and 70 % canopy pruning. Levels of canopy pruning were based on a percentage of green crown length and calculated on the basis of the method described by Samaddar & Chakrabarti (1988) and Pilania et al. (2010). The experiment was laid out in complete randomize block designed with 3 replications. The field spice crop viz., Ginger was grown sequentially as intercropping under tree. Pruning was done during off season atleast a month before planting of ginger. In the next year, intercropping was done under previous pruning season growth canopy. Growth parameters of mandarin orange, diameter at breast height (dbh), height, canopy diameter, fruit number/tree and kg/tree were measured in January whereas ginger height, leaf diameter and rhizome yield/plant were determined in February in both the year. The man power required for the pruning was determined on the basis of cost treatment and yield/plant. The net income was obtained by subtracting the treatment cost from gross income. It was expressed on net excess income over control.

3. Results and Discussion

Effect of pruning intensity on the growth of tree

The canopy pruning and intercropping significantly influenced the growth of an orange tree. The growth parameter (DBH, height and canopy diameter) of the tree in Table 1 reveals that the pruned tree had better growth parameter than the control.

The development and growth of tree during 2011 was better than the 2010. The tree The DBH did not exhibit significant variation, however height and canopy diameter was significantly (P=0.05) affected with pruning intensity and intercropping. The 50 % pruning of previous season (2011) growth canopy had significantly higher rate of DBH, height and canopy diameter growth than 50 % canopy pruning season (2010). The higher tree growth and canopy diameter may be probably due to higher organic sources and moisture retention with intercropping under tree (Newaj et al. 2005). Among the pruning intensities, the trees in control had higher DBH, height and canopy diameter than 50 % and 70 % canopy pruning. However, the rate of growth in the tree at 50 % and 70 % canopy pruning had higher than control Generally, it has been found that the impact of pruning on tree growth increased with the amount of the pruning with 5.7 % and 3.7 % as compare to 1.7 %. This may be due to the rejuvenation process which encourages nutritional status and physiological activities of the tree. intensities (Chandrashekhar 2007 and Newaj et al. 2010) which may be due to change in development activities of the tree after pruning as it removes old leaves, unproductive and infected branches. The Pruning of *Albizia procera* tree and cropping sequence with leguminous crop have been reported to benefit higher tree growth and canopy diameter by Newaj et al. 2010.

The average yield data of 2010 and 2011 reveals that the number of fruit/tree and kg/tree under different pruning intensity significantly increase as compare to control. The maximum increase in number of fruit/tree and kg/tree from 2010 to 2011 was recorded at 50 % canopy pruning with 50 No's of fruit/tree and 1.13 kg/tree followed by 70 % canopy with 23 No's of fruit/tree and 0.44 kg/tree while control (unpruned) had decline result with 0.06 No's of fruit/tree and 0.05 kg/tree respectively. These findings were in close conformity with findings of Pilania et al. (2010) maximum fruit yield in Guava at 50 % canopy pruning. The significant interactive effect as a consequence of organic sources, light and intercrop alley attributed a favorable nutritional status and moisture content in the soil resulting into increased biomass production in the tree. B: C ratio was significantly affected by pruning intensity and cropping sequence. The pruning intensity obtained maximum B: C at 50 % canopy with 4.32 as compared to 70 % canopy and control during both the season.

Rhizome yield of intercrop

The growth and yield of ginger as the intercrop under orange tree shows significant variation at different pruning intensities. The plant height, number of leaves and rhizome/plant increased with increase in the pruning intensity. However, the growth and yield of intercrop during pruning year 2010 was considerably higher than the next cropping season 2011. The growth and rhizome yield was significantly higher at 70 % and 50 % canopy pruning than control. The plant height, leaves number and rhizome yield/plant of intercrop was 40.71 cm, 3.92 Nos & 77.32 g at 70 % canopy pruning higher than 50 % canopy pruning and control during 2010. However, there were decline in growth and yield in the next crop season except, for 50 % canopy pruning which increase significantly with 38.66 cm, 3.78 No's & 72.20 g/plant.

This may be due to regulation of temperature and light intensity under tree canopy indicating more compatibility for crop growth. In agri-horticulture system, canopy pruning of fruit tree facilitates penetration of light and alleviates shading of understorey crop. Newaj et al. (2010) reported higher grain yield of greengram and wheat under leguminous and non-leguminous cropping sequence intercropped under white siris tree which was pruned at different level. In another study, Newaj et al. (2007) also reported high yield of blackgram and mustard at 50 % canopy pruning

Table 1. Effect of pruning intensity and cropping sequence on the growth of orange tree.

Pruning intensity	2010			2011			Growth rate
	DBH (cm)	Height (m)	Canopy dia (m)	DBH (cm)	Height (m)	Canopy dia (m)	
70 % canopy	13.72	4.61	2.71	13.74	4.72	2.82	3.7 %
50 % canopy	13.75	4.14	2.64	13.78	4.25	2.78	5.7 %
Control (unpruned)	14.09	5.02	2.92	14.08	5.08	2.98	1.7 %
CD (P=0.05)	0.86	0.28	1.18	0.93	0.74	1.47	2.30

Table 2. Effect of pruning intensity on yield and B: C ratio of orange.

Treatment	No. of fruit/tree		Yield (kg/tree)		B:C ratio
	2010	2011	2010	2011	
70 % canopy	470	493	20.81	21.25	4.03
50 % canopy	351	401	17.78	18.91	4.32
Control (unpruned)	685	679	27.13	27.08	3.87
CD (P=0.05)	6.32	6.41	1.93	1.18	0.87

Table 3. Effect of pruning per cent on the growth and yield of intercropped ginger.

Pruning intensity	2010			2011		
	Height (cm)	No. of leaves/ plant	Weight/plant (g)	Height (cm)	No. of leaves/ plant	Weight/plant (g)
70 % canopy	40.71	3.92	77.32	40.20	3.90	76.66
50 % canopy	37.32	3.15	70.71	38.66	3.78	72.20
Control (unpruned)	33.43	3.08	58.43	32.57	2.88	55.47
CD (P=0.05)	0.35	0.07	1.50	1.50	1.29	1.29

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