

Performance of two carrot varieties under goraneem based multistoried agroforestry system

M. Omar Ali¹, M.A. Rahim² and M.S. Bari³

¹Department of Agroforestry, ²Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202

³Department of Agroforestry, Hajee Mohammad Danesh Science and Technology University, Dinajpur

Abstract: The experiment was conducted at the Germplasm Centre, Horticulture farm, Bangladesh Agricultural University, Mymensingh during the period from October, 2006 to April, 2007 to evaluate the performance of two carrot varieties under multistoried cropping system. The experiment consisted of two carrot varieties viz., NK and SB and three cropping system viz., sole cropping, goraneem + lemon based multistoried cropping system and goraneem + guava based multistoried cropping system with three replications following the RCBD design. In the three layered cropping systems, goraneem was planted as upper storey multipurpose trees, guava and lemon was established as middle storey fruit crops and carrot was cultivated as ground storey crops. The results revealed that as sole cropping, variety NK gave better performance than that of variety SB. Again, both the varieties produced maximum yield in sole cropping. In multistoried cropping system, goraneem + lemon based multistoried agroforestry system, gave better performance (NK 23.83 and SB 17.03 t/ha). Then goraneem + guava based multistoried agroforestry system (NK 12.41 and SB 12.00 t/ha). Except plant height and length of leave all other parameters were significantly lower in multistoried agroforestry system than sole cropping. The economic analysis showed that multistoried cropping of variety NK with goraneem+lemon was beneficial in terms of total net return from a unit area and time.

Key words: Goraneem, Lemon, Guava, Multistoried Agroforestry system, Carrot

Introduction

Incorporation of forest trees, fruit trees and vegetables in multistoried cropping system can be an effective and compatible Agroforestry system. Traditionally farmers of Bangladesh grow different types of crops in association with trees in their homesteads or farmlands where productivity of crops is low due to lack of appropriate combinations and management techniques. For identifying the compatible tree crop combinations, particularly under storey species should be screened out in terms of their adaptability and yield under different shade levels created by the upper storey tree species. For this purpose, the best way of experimentation is to grow different crops under different trees species. Guava (*Psidium guajava*) and lemon (*Citrus lomon*) are two important fruit crops of Bangladesh. *Melia azedarach* Linn, locally known as goraneem, one of the most important selected multipurpose trees, almost found in all strata of Bangladesh and goraneem based cropping systems seems to be an alternative to combat the hostile edaphoclimatic conditions for their profitable utilization (Khan and Alam, 1996). Again, Carrot (*Dacus carota* L.) is also an important carotene rich root crops (Chowdhury 1979). It is used in preserves, pickles and sweetmeats. It is also used for making Halwa, Gajor Pak and Carrot pudding (Gajrela) which is very popular desert (Chauhan, 1989). To prevent malnutrition problem carrot can play a significant role as it contains high nutritional values. Carrot can be successfully grown in different multistoried agroforestry systems. But the growth and yield performance of all kinds of (varieties) carrot are not equal under different multistoried agroforestry systems. Keeping this view in mind this research has been under taken to find the suitable variety of carrot which is adaptable under goraneem based multistoried agroforestry system.

Materials and Methods

The study was conducted on the existing goraneem based multistoried garden at the Germplasm centre of Department of Horticulture, Bangladesh Agricultural University, (BAU), Mymensingh during the period from October, 2006 to April, 2007. The experimental site is situated under tropical monsoon climate characterized by heavy rainfall during the months from April to September and then scanty rainfall during the rest period of the year. The soil texture was sandy loam with a pH 5.8-6.8. The structure of the soil was fine and the organic matter content was 1.80%. Two carrot (*Dancus carrota*) varieties NK and SB were used and each variety (NK or SB) was laid out in a (RCBD) under three treatments with three replications. Treatments were:

- (a) T₁ = Carrot under full sunlight (open condition)
- (b) T₂ = Goraneem + Lemon + Carrot
- (c) T₃ = Goraneem + Guava + Carrot

In treatment T₁ sunlight was allowed to fall over the carrot without any barrier which was considered as 100 per cent light level. Treatment T₂ was a three layered canopy configuration consisted of goraneem, lemon and carrot. The carrot was in ground layer, five years old lemon plants in middle layer in fruits condition (spacing 3m×3m) and goraneem occupied upper layer spacing 6m×6m). Treatment T₃ was also three layered where middle layer consisted with six years old Guava plants which were three in full bearing condition (spacing 3m×3m) and other layers like as T₂. Carrot seed were collected from USDA Allium field lab, BAU, Mymensingh. The seeds of carrot were directly sown in the experimental plots on 10 October, 2006, maintaining the spacing of continuously at 25-30 cm apart lines. After emergence, carrot plants were thinned out by maintaining 20-25 cm distance from plant to plant. Recommended doses of fertilizer (BARC, 1999) were used for the carrot. The experimental plots were kept weeds free by weeding

frequently. The plots were irrigated whenever needed by using hose pipe and watering cane. Carrot harvesting was started at 90 days after planting and continued up to 125 days. Economics of various treatments was calculated taking into account the current costs of inputs and produce. The data on various growth and yield performance characters of the tested varieties were statistically analyzed to examine the significant variation of the results due to different shading condition. The analysis of variance for each of the studied character was done by F (Variance ratio) test following RCBD. The treatment means were compared at 1 and 5 per cent level of significance (using MSTAT computer program and Excel program).

Results and Discussions

Effect of varieties on the growth and yield contributing characters of Carrot

The plant height of carrot was significantly affected by the influence of varieties (Table 1). Results revealed that the variety NK produced longer plant height (50.24cm) where as SB possessed shorter plant height (47.77). But there was not significant variation on number of leaves per plant. The number of leaves per plant of NK was 8.99 whereas SB was 8.81. The results showed that length of carrot leaf was significantly different (at 5% level) by the effect of varieties. The higher length of leaf was found (44.69 cm) under NK whereas the lowest length leaf was produced (40.27 cm) in SB. Again, the two varieties showed non-significant variation on length of carrot root. NK variety was produced 11.21 cm length root whereas SB carrot produced 10.97 cm. Similarly, those two varieties showed non-significant variation on diameter of fruit. The variety NK produced 15.08 cm)and the variety SB produced 14.24 cm. Incase of weight of carrot fresh root, significantly higher weight (157.03 g) was found in NK variety whereas SB produced lower weight (122-77 g).

Effect of varieties on the yield (ton/ha) of carrot

Results revealed that two varieties showed significant variation on yield (Table 4). NK variety produced

higher yield (23.55 t/ha) whereas SB variety gave lower yield (18.41 t/ha).

Effect of multistoried cropping system on the growth and yield contributing characters of Carrot

The effect of multistoried cropping system on growth and yield contributing characters of carrot were significant (Table 2). The tallest plant was found (57.30 cm) in T₂ (partial shade condition). The smallest plant was found (43.26 cm) in T₃ (Severe shade condition) which was statistically similar to T₁ (open condition). This was probably due to higher apical dominance under shade condition (Hillman, 1984). Again, results showed that number of leaves per plant was significantly different by the effect of multilayer. The maximum number of leaves per plant was found (10.55) in T₂ (partial shade condition) whereas the lowest number of leaves per plant was found (7.44) under T₁ (control condition). Significantly the maximum length of leaf was found (54.20 cm) in T₂ (partial shade condition) and the lowest length of leaf was produced (32.98 cm) under T₁. The vegetative growth is increased due to increased of shade level. Similar results were also reported by Miah (2000). The length of the carrot root was also significantly influenced by the different multilayers cropping system. The longest carrot root (13.66 cm) was observed under treatment open field. The shortest carrot root length (8.94 cm) was found under T₃. Incase of diameter of roots, significantly The highest carrot diameter (18.16 cm) was observed in open field. The lowest carrot diameter (11.90 cm) was recorded under T₃ (under severe condition).

Again, significantly the highest weight of fresh carrot roots per plant was formed (203.13 g) in full sunlight and the lowest weight of fresh root was formed (108.00 g) in T₃.

Effect of multistoried cropping system on the yield (ton/ha) of carrot

The yield of carrot was also varied greatly by the effect of multistoried cropping system (Table 2). The highest yield was found (30.32 t/ha) under full sunlight and the lowest yield was found (12.20 t/ha) under T₃ (Govaneem + Guava based agroforestry system).

Table 1 : Effect of varieties on yield and morphological characters of carrot

Varieties	Plant height (cm)	Number of leaves/ plant	Length of leaf(cm)	Length of root(cm)	Diameter of root(cm)	Weight of fresh root (g)	Yield (ton/ha) (Fresh root)
NK	50.24a	8.99	44.69a	11.21	15.08	157.03a	23.55a
SB	47.77b	8.81	40.27b	10.97	14.24	122.77b	18.41b
Level of significance	**	NS	*	NS	NS	**	**

In a column, figures having the similar letter (s) or without letter (s) do not differ significantly as per DMRT

** = Significant at 1% level of probability

* = Significant at 5% level of probability,

NS = Not significant,

Table 2: Effect of multilayer on yield and morphological characters of carrot

Multilayer	Plant height (cm)	Number of leaves/ plant	Length of leaf (cm)	Length of root (cm)	Diameter of root (cm)	Weight of fresh root (g)	Yield (ton/ha) (Fresh root)
T ₁	46.43b	7.44c	32.98c	13.66a	18.16a	202.13a	30.32a
T ₂	57.3a	10.55a	54.20a	10.66b	13.92b	136.20b	20.43b
T ₃	43.26c	8.72b	40.26b	8.94c	11.90c	81.38c	12.20c
Level of significance	**	**	**	**	**	**	**
CV (%)	2.05	4.78	7.78	6.48	7.63	2.31	6.61

Interaction effect of varieties and multistoried cropping system on the growth and yield contributing characters of Carrot

Plant height of carrot varieties was significantly different due to interaction effect of multistoried cropping system and varieties (Table 3). Variety NK produced the longest plant height (59.60 cm) under T₂ treatment whereas the variety SB showed the lowest plant height under T₃ treatment. The reasons might be carrot is a partial shade loving crop. It cultivated under shade more vigorously than those cultivated in open field. Similarly higher plant height under reduced height levels was observed in carrot (Miah, 2001). Incase of number and length of leaves per plant, Interaction effect of variety and treatment was shown non-significant. But, Length of carrot root of varieties was significantly different (at 5% level of significance). The highest length of carrot root of NK variety was found (14.59 cm) in T₁ treatment (open condition). The lowest length of carrot root of NK variety was found (8.33 cm) in T₃ which was identical to SB variety under T₃. Again, the variety NK produced the highest diameter of root produced (18.81 cm) under T₁ (open condition) as compared to than that of other treatments. NK variety produced the maximum weight (229.44 g) under T₁ (open condition). SB variety showed the minimum weight of carrot fresh root under

T₃ treatment which was similar to NK under T₃ treatment.

Interaction effect of varieties and multistoried cropping system on the yield (ton/ha) of Carrot

Yield of carrot varieties was significantly different due to interaction effect of multistoried cropping and varieties (Table 3). Variety NK produced the highest yield (34.41 t/ha) under (fill sunlight). SB variety showed the lowest yield under T₃ (Govaneem+ Guava based agroforestry system) which was identical to NK variety under T₃ (Govaneem + Guava based agroforestry system).

Economic analysis of Carrot production under multistoried cropping system

Economic analyses of data indicated considerable variation was present among the varieties as well as the different multistoried cropping system (Table 4). As sole cropping growing of NK variety of carrot was remunerative in comparison to variety SB. Maximum Benefit Cost Ratio (BCR) 4.66 was observed in NK variety of carrot in sole cropping system. Again, variety NK gave the highest BCR (5.29) in goraneem+lemon based multistoried cropping system, indicating that multistoried cropping of variety NK with goraneem+lemon was beneficial in terms of total net return from a unit area and time. Similar trend was also followed by variety SB.

Table 3: Interaction effect of variety and multilayer tree arrangement on yield and morphological characters of carrot

Interaction	Plant height (cm)	Number of leaves/ plant	Length of leaf (cm)	Length of root(cm)	Diameter of root(cm)	Weight of fresh root (g)	Yield (ton/ha) (Fresh root)
NKT ₁	45.73c	7.80	34.74	14.59a	18.81	229.44a	34.41a
NKT ₂	59.60a	10.55	56.63	10.70c	14.55	158.89c	23.83b
NKT ₃	45.40c	8.62	42.70	8.33d	11.89	82.77e	12.41d
SBT ₁	47.13c	7.07	31.23	12.74b	17.51	174.81b	26.22b
SBT ₂	55.06b	10.55	51.78	10.63c	13.29	113.51d	17.03c
SBT ₃	41.13d	8.81	37.81	9.55cd	11.92	80.00e	12.00d
Level of significance	**	NS	NS	*	NS	**	**

Economic analysis of Carrot production under multistoried cropping system

Economic analyses of data indicated considerable variation was present among the varieties as well as the different multistoried cropping system (Table 4). As sole cropping growing of NK variety of carrot was remunerative in comparison to variety SB. Maximum Benefit Cost Ratio (BCR) 4.66 was observed in NK variety of carrot in sole cropping system. Again,

variety NK gave the highest BCR (5.29) in goraneem+lemon based multistoried cropping system, indicating that multistoried cropping of variety NK with goraneem+lemon was beneficial in terms of total net return from a unit area and time. Similar trend was also followed by variety SB. This study suggests that both varieties are suitable for agroforestry systems. For Goraneem Multistoried Agroforestry production system NK variety is beneficial.

Table 4. Economics of carrot production under goraneem based multistoried cropping system

Variety	Treatment s	Return from Carrot (Tk./ha)	Return from lemon (Tk./ha)	Return from guava (Tk./ha)	Return from goraneem (Tk./ha)	Gross return (Tk./ha)	Total cost of production (Tk/ha)	Net return (Tk./ha)	BCR
NK	T ₁	258075	-	-	-	258075	55378	202697	4.66
	T ₂	178725	33012	-	83400	295137	55843	239294	5.29
	T ₃	93075	-	36192	83400	212667	56360	156307	3.77
SB	T ₁	183540	-	-	-	183540	55378	128162	3.31
	T ₂	127725	33012	-	83400	211158	55843	155315	3.78
	T ₃	84000	-	36192	83400	203592	56360	147232	3.61

Note: T₁=Open field condition (Full sunlight); T₂=Goraneem+Lemon based agroforestry system

T₃=Goraneem+Guava based agroforestry system; Lemon @ Tk.1.25/lemon, Guava @Tk.1.20/guava, Goraneem Tk. @ 300/goraneem tree.

References

- BARC. 1999. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Dhaka.
- Chauhan, V.V.S. 1989. Cole crops. Vegetable production in India. Agra, India. pp. 117-147.
- Chowdhury, B. 1979. Vegetable National Book Trust, New Delhi, India, p. 88.
- Hillman, J.R. 1984. Apical dominance, In: Wilking; M.B. (ed.) Advanced plant physiology, pitman, London, pp. 127-148.
- Khan, M.S. and Alam, M.K. 1996. Homestead flora of Bangladesh. BARC, IDRC and SDC : 167-168
- Miah, M.M. 2001. Performance of five winter vegetables under different conditions for agroforestry systems, M.S. thesis BSMRAU, Gazipur, Bangladesh