Broadleaf Mustard Production during Dry Season by Altering Husbandry Practices

Purushottam P. Khatiwada[1]

ABSTRACT

A field experiment was conducted to identify suitable plant spacing and harvesting methods for green leaves production of broadleaf mustard during off-season (April to June). The experiment was designed in two factor factorial arrangements in randomized complete block design with three replications. First factor was harvesting method and the second was different plant spacing. The study has shown that green leaves of broadleaf mustard can be successfully produced in the dry season in the areas of high and upper mid hills having irrigation facility. Between periodic harvest and whole plant harvesting, periodic harvest yielded significantly higher ($p<.001$) green leaves. The results revealed that the green leaf production was significant ($p<.001$) among the different plant spacing. Results showed that 45x10 cm spacing was suitable for periodic harvest and 30x10 cm for whole plant harvest. The results have clearly shown that plant population per unit area can be reduced by at least three folds for periodic harvest and four folds for whole plant harvest then that of normal season for the dry season production.

INTRODUCTION

Broadleaf mustard (*Brassica juncea* L. Czern. and Coss.) is a widely accepted and cultivated leafy vegetable in Nepal. The Master Plan of Horticulture Development has illustrated that broadleaf mustard (BLM) is consumed in the highest quantity (5.73kg/capita/year by semi-commercial and 3.43 kg/capita/year by subsistence farmers) in national level (MOA/ADB, 1990). A survey carried out in the eastern hills revealed that hundred percent of farmers having personal contact with agricultural technicians and 79 percent of farmers not having direct access to with agricultural technicians cultivated BLM in their kitchen gardens (Joshi *et al*., 1990). The strong and pungent taste of BLM is highly preferred by the Nepalese consumers. Its popularity could be due to easy cultivation, low production risk, traditional in nature and versatile uses. Scarcity of leafy vegetables during other than the main season (November – February) is an identified problem in Nepal because of failure to cultivate BLM, spinach and cress. The recommended alternative leafy vegetable during the summer season is Swiss chard. However, it has not been preferred by the majority of the consumers in the hill of Nepal due to strange and dull taste. It could be the reason of growing even poor quality of BLM during autumn and rainy seasons. It has been experience that even very poor quality leaves produced in the rainy (April-July) get higher prices than the quality leaves of the normal season production.

Husbandry practices adopted in the summer season production of BLM were entirely based on the available literature (for normal season) and experiences of researchers, not based on the research findings. The recommended spacing for BLM in Nepal is 30x10-15 cm (VDD, 1990). However, 45x30 cm spacing has been recommended for normal season for Sikkim hills (Subba, 1991). In the same connection, experience has shown that 30x15 cm spacing

[1] Nepal Agriculture Research Council, Horticulture Research Division, Khumaltar, Lalitpur

was very close for normal season and very wide for the summer season at Pakhribas condition. It is due to suitable growing environment in winter season and adverse in the summer season.

In the summer season, the production period was very short due to early bolting. Appropriate plant spacing is the key husbandry aspect for the improvement of productivity of crops in general and BLM in particular. Leaf harvesting methods seem very inefficient in summer production due to short harvesting period. Thus, there is an apparent need to identify the alternate husbandry method, so as to increase the quality leaf (good in appearance and smooth in texture) yield per unit area. Owing to this problem, an experiment was designed with objectives to identify the appropriate plant spacing for maximizing the marketable leaf yield and to determine the productivity of BLM per unit area during dry season (April-June) with different methods of harvesting.

MATERIALS AND METHODS

A formal experiment was carried out for three consecutive years (2000 to 2002) at an altitude of 1750 m asl in south facing slope at Agriculture Research Station, Pakhribas, Dhankuta. Seed of Marpha Broadleaf variety of BLM was sown in the 4th week of February under plastic tunnel. The covering plastic sheet was removed the day time after germination of the seed. The experiment was designed in a randomized complete block design with two factors factorial treatment arrangements with three replications. The first factor was harvesting methods (whole plant and periodic harvest) and the second factor was nine plant spacing (45x30 cm, 45x20 cm45x10 cm, 30x30 cm, 30x20 cm, 30x10 cm, 15x30 cm, 15x20 cm, 15x10 cm). Plot size for the experiment was 2.16 m^2 (1.8m x 1.2m) in the first year and 3.24m^2 (1.8 x 1.8m) in the second and third year. General border row was maintained for a replication and yield was recorded from the entire plot. Compost was applied at the rate of 20 t/ha at the time of land preparation. Elemental N, P, K and Malathion dust (20%) were applied at the rate of 25, 25, 50 and 20 kg/h respectively at the time of final land preparation. Remaining a half dose of nitrogen (25t/ha) was top dressed after 30 days of transplanting in the first year and after 20 days in the second and third year. Thirty to thirty-two days old seedlings were transplanted in the experimental plots. Watering was done daily for initial four days of transplanting. Problem of flea beetle and aphids were recorded in all the years and Thiokill (endosulphan) at a rate of 1.5 ml/L of water was sprayed at once in the later stage. Irrigation was provided to ensure sufficient soil moisture in the field. Weeding was done at fortnightly interval to keep the field clean. All data collected from three years were pooled and analyzed using Ganstat software.

RESULTS AND DISCUSSION

Marketable yield

Marketable leaf yield of broadleaf mustard is the most crucial parameter to determine the success or failure of the crop in a particular season. The average production (31.9 t/ha) demonstrated that BLM green leaves can be produced successfully in dry season (April-June). The analysis of variance of marketable yield revealed a significant interaction between methods of harvesting and plant spacing at $p<.05$. Closer spacing namely 30x10cm, 15x30cm, 15x20 and 15x10 yielded significantly higher leaf yield and was statistically at par in the case of whole plant spacing. On the other hand, relatively wider

spacing *viz* 45x10cm, 30x20cm and 15x30cm yielded statistically similar higher yield from the periodic harvest (Table 1). All the spacing fell in a single statistical range are principally indifferent. However, considering the weak statistical probability and wide row to row spacing (which ease the intercultural operations) 45x10 cm spacing for periodic harvest and 30x10 cm for whole plant harvest have been recommended. Generally, the marketable yield increased along with the increasing plant population in the case of whole plant harvesting (Fig.1). On the other hand, yield reached in the plateau and started to decline at plant population beyond 166,666/ha for periodic harvest.

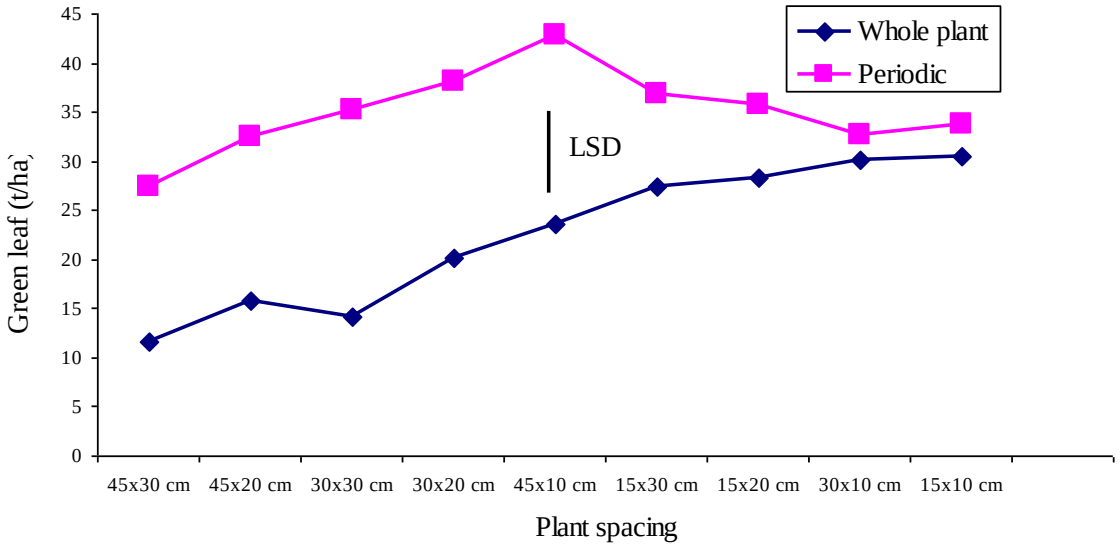

Figure 1. Mean green leaf yield of broadleaf mustard in different harvesting methods and plant spacing.

The yield obtained from Marpha Broadleaf in the dry season is far less (31.9t/ha) than the normal season production (50t/ha) under Pakhribas conditions (Khatiwada *et al.*, 1997). However, the yield seems acceptable for the season as the production was sold at local Haat at the rate of Rs. 5-10/kg, which was 3-6 times higher than the normal season price of the study period. The significantly lower yield from the whole plant harvesting also seems worth considering if labour, water requirement and land coverage over time are considered.

Unmarketable yield

Unmarketable leaf yield included leaves undesirable to consume due to diseases, insects and other mechanical damages. The analysis of variance result of unmarketable yield demonstrated that interaction effect of harvesting methods and spacing was significantly different at $p<.001$. Closest planting (15 cm x 10 cm) with periodic harvest gave the highest unmarketable yield (Fig.2). The unmarketable yield from the closest spacing and whole plant harvest was significantly ($p<.001$) lower than that of the widest (45 cm x 30 cm) spacing and periodic harvest method.

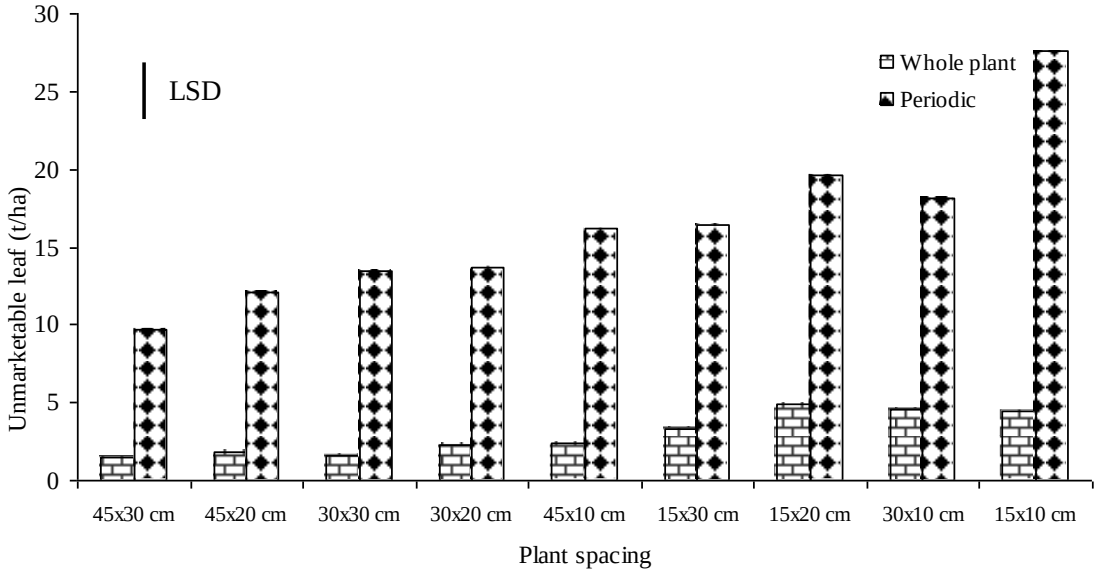

Figure 2. Mean unmarketable leaf (t/ha) obtained from different spacing and harvesting methods.

Unmarketable yield (9.65t/h) was found much higher in the dry season than that of normal season. Khatiwada *et al.* (1997) reported that unmarketable yield was only 7.3 t/ha for 4 harvesting periods during the normal (winter) season. The reasons of higher unmarketable leaf were due to hails and more attack of diseases and insects. Hails broke the leaf lamina and the damaged or torn leaf loose its marketability. In the eastern hills, April – May is more hails prone season than the winter. Leaf spots (basically by *Alterneria spp*.) were noticed much higher in close spacing than the wider spacing and more unmarketable yield was the result of leaf spots.

Plant height

Plant height was recorded to understand the effect of spacing on plant geometry. There was a strong evidence ($p<.001$) to support that the interactive effect of methods of harvesting and spacing was prominent significantly shorter plant height (26.33-29.53 cm) was observed in the population closer than 45x15 cm except in 30x30 cm. Non-significant difference ($p<.05$) due to spacing and significantly ($p<.001$) different in harvesting method on plant heights reveal that broad leaf mustard takes it full height during the early growth period. The decrease in the plant height was recorded along with the increase in number of harvest.

Plant spreading

Effect of the methods of harvesting and spacing was significant ($p<.001$) on plant spreading similarly, the interactive effect of plants spacing and methods of harvesting was significant at $p<.05$ on plant spreading. Poor (21.75cm) plant spreading was recorded in the closest (15x10cm) spacing in the periodic harvest, while the highest spreading was recorded in the widest (45x30 cm) spacing in whole plant harvest. As expected, wide spacing showed greater spreading than closer spacing.

Table 1. Mean values of yield and plant height and spreading of Marpha Broadleaf under different spacing and harvesting methods.

Method of harvesting	Plant spacing	Marketable yield (t/ha)	Unmarketable yield (t/ha)	Plant height (cm)	Plant Spreading (cm)
Whole plant	45x30	11.60	1.47	31.93	47.73
	45x20	15.76	1.88	30.4	40.60
	45x10	23.67	2.45	34.33	32.7
	30x30	14.11	1.55	28.68	38.51
	30x20	20.08	2.28	31.73	35.67
	30x10	30.21	4.55	34.67	30.47
	15x30	27.46	3.32	35.80	36.63
	15x20	28.39	4.89	33.47	27.03
	15x10	30.53	4.48	31.4	34.07
Periodic	45x30	27.31	9.68	31.4	43.42
	45x20	32.53	12.08	32.63	41.63
	45x10	42.74	16.18	29.53	32.1
	30x30	35.25	13.44	28.8	35.15
	30x20	38.15	13.66	30.65	31.15
	30x10	32.59	18.15	27.43	26.4
	15x30	36.76	16.41	28.03	31.23
	15x20	35.79	19.61	26.73	25.22
	15x10	33.66	27.62	26.33	21.75
F-ratio		*	***	***	*
s.e.d. (method of harvesting)		1.44	0.56	0.58	0.72
s.e.d. (spacing)		3.05	1.18	1.24	1.52
s.e.d. (harvesting x spacing)		4.31	1.67	1.75	2.16
CV (%)		26	30.1	9.9	11

s.e.d. = standard error of difference

* - significant at 5% ** - significant at 1% *** - significant at 0.01%

Leaf length

Average leaf length was recorded to be 29.09 cm from petiole to the tip of lamina. Analysis of the leaf length showed significant (p<.001) effect due to plant population at different spacing and harvesting methods. The average length of 5 leaves form the whole plant harvest was 30.96 cm in comparison to the 27.21 cm in periodic harvest. The leaf length increased along with the decrease in plant population. Plants of the spacing greater than 30x30 cm had the significantly longer leaf length (29.66-30.45cm) and the significantly shortest (26.54cm) leaf length was recorded in the plants from 15x10 cm spacing.

Marpha Broadleaf had 33.3 cm leaf length and 18 cm breadth in the normal season (Khatiwada *et al*., 1997). Hence, leaf length decreased in the summer season. The perusals of raw data showed that the leaf length decreased along with the number of harvest or the age of the plants in periodic harvest. However, the observation was taken only from the outer leaves of whole plant harvesting method.

Table 2. Mean value of leaf length and width of Marpha Broadleaf under different growing spacing during dry season

Method of harvesting	Spacing (cm)	Leaf length (cm)	Leaf width (cm)
Whole plant		30.9	14.63
Periodic		27.21	14.59
F-ratio		***	ns
	45x30	30.45	15.83
	45x20	29.66	15.49
	45x10	30.86	15.36
	30x30	29.38	14.99
	30x20	28.68	14.39
	30x10	27.86	13.83
	15x30	29.91	15.22
	15x20	28.48	13.83
	15x10	26.54	12.54
F-ratio		***	***

* - significant at 5% ** - significant at 1% *** - significant at 0.01%

Leaf width

The average width of the leaf was 14.61 cm, which was also much smaller than the normal season average width (18cm). Analysis of variance has showed that the spacing have significant effect ($p<.001$) on the leaf width (Table 2). The plants at closer spacing had the small sized leaves. However, the method of harvesting and interaction of spacing and methods of harvesting did not have effect n leaf width.

Days to harvest

Plants were ready for harvesting after about a month of transplanting. Whole plants were harvested 34 days after transplanting in all years. At the time of harvesting average number of leaves per plant were 8.3 with standard deviation of 0.71.

On the other hand, five harvests at a weekly interval were done in periodic harvesting and which was continued for about two and a half months of transplanting. Bolting occurred after fifth harvest as a result further harvesting could not be taken. The number of harvest is satisfactory compared to the normal season. But the production period is quite shorter as compared to the normal season harvesting. Green leaves of Marpha Broadleaf can be harvested up to 6 months of transplanting in the normal season (Khatiwada *et al*., 1997).

Bolting

First bolting was recorded from 38 to 60 days after transplanting in different treatments. The bolting was observed earlier in the close planting than the wide spacing. All plants of all the treatments were bolted after 73 and 77 days of transplanting in the first and second year respectively. In an another study conducted in normal season, Khatiwada *et al.* (1997) recorded 50% bolting of Marpha Broadleaf after 118 days of transplanting when the seedlings were transplanted in the 3rd week of October. The early bolting could be due to the higher temperature in the growing season.

CONCLUTIONS

The results elucidated that green leaves production of broadleaf mustard is feasible in upper mid hills during dry and summer season. Periodic harvest yielded more green leaves in aggregation than that of whole plant harvesting at a time. The result clearly showed that single spacing is not suitable for both methods of harvesting. Considering the biological yield and cultivation practices, most suitable spacing has been identified 45 cm x10 cm spacing for periodic harvest and 30 cm x10 cm for whole plant harvest. Thus, it can be concluded from the experiment that whole plant harvest is suggested in the areas where irrigation and labour is abundantly available. In the irrigation and labour shortage situations, periodic harvest seems suitable. Leaf spots due to *Alterneria spp*. was the main cause for making leaves unmarketable. Hence, crop rotation and seed treatment is suggested for the periodic harvest.

REFERENCES

MOA/ADB, 1990. Master Plan for Horticulture Development Vol. 1. Prepared for HMG/Nepal, Ministry of Agriculture and the Asian Development Bank by Pacific Management Resources Inc., USA in association with East Consult (P) Ltd., Nepal.

Joshi, Y. R., A. R. Sharma, U. P. Rai and B. K Mitchelhill, 1990. Monitoring and valuation of the kitchen garden programme in local target area of Pakhribas Agricultural Centre. PAC Technical Paper No. 140. Pakhribas Agricultural Centre, Dhankuta, Nepal.

Khatiwada, P. P., S.R. Gautam, M. P. Thapa, G. Neupane and B. H. Baral, 1997. A review of broadleaf mustard research at PAC (1987-1992) PAC UWP No. 8. Pakhribas Agricultural Centre, Dhankuta, Nepal.

Subba, J. R., 1991. Vegetable in Sikkim (In Nepali- Sikkim Ka Sagsabji) Department of Agriculture, Government of Sikkim, Gangtok, Sikkim.

VDD. 1990. Vegetable Cultivation in Nepal (In Nepali – Nepal Ma Tarkari Kheti). Vegetable Development Division, Khumaltar.