Bangladesh Agron. J. 2021, 24(1): 37-42

INFLUENCE OF TWIG REMOVAL ON YIELD AND ECONOMICS OF PEA VARIETIES

S.S. Kakon, S.M.A.H.M. Kamal[1], M.A.K. Mian, R.R. Saha[2] and M.A. Hossain[3]

Agronomy Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur
[1]Breeder Seed Production Centre, Debigonj, Panchaghor, Bangladesh Agricultural Research Institute
[2]Oil Seed Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur
[3]On-farm Research Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur
Corresponding E-mail: kakonbari@gmail.com

(**Received**: 30 January 2020, **Accepted**: 12 April 2021)

Keywords: Twig removal, leafy vegetable, yield, BCR, pea

Abstract

The experiment was conducted at the Research field of Agronomy Division, BARI, Joydebpur, Gazipur during *rabi* seasons of 2016-2017 and 2017-2018 to evaluate the effects of twig removal on yield and yield attributes, and extra benefit incurred due to removal of twig as a leafy vegetable in pea varieties. Treatments consisted of three varieties such as V_1=Natore local, V_2 = BARI Motorshuti-1 and V_3= BARI Motor-1 and five twig removal variables, viz. T_1= control (no removal), T_2 = removal of 5 cm twig at 25 DAE, T_3= removal of 7.5 cm twig at 25 DAE, T_4=removal of 10 cm twig at 35 DAE, T_5= removal of 12.5 cm twig at 35 DAE. Leafy vegetable yield varied among the varieties and twig removal variables. The highest leafy vegetable yield (778 and 975 kgha^{-1}) over the years was recorded in BARI Motorshuti-1 when 12.5 cm twig removed at 35 days after emergence which was at par with BARI Motor-1 at the same cutting time and the same length. The maximum pod yield (9.15 t ha^{-1} and 9.52 t ha^{-1}) was recorded in BARI Motorshuti-1 when 5cm twig removed at 25 days after emergence (DAE), which was statistically similar to the same variety with twig removal of 7.5 cm at 25 DAE. The highest gross return (Tk. 76522.00 ha^{-1}), gross margin (Tk.48272.00 ha^{-1}) and BCR (2.71) was recorded in BARI Motorshuti-1 when twig removed 5 cm at 25 DAE, which was similar to the same variety with 7.5 cm twig removed at 25 DAE. The result revealed that 5-7.5 cm twig removal at 25 DAE from the tip might be a profitable technique for pea (var. BARI Motorshuti-1) production for dual purpose as vegetables and pod yield.

Introduction

Pea (*Pisum sativum* L.) is one of the most important leguminous vegetable crops grown during the winter season in Bangladesh for local consumption. The crop is a major source of protein (21% - 25%) with high levels of amino acids, lysine and tryptophan that have high nutritional value (Bhat *et al.*, 2013; Gregory *et al.,* 2016).

Pea is grown in an area of 10 379 535 hectares, with a total production of 10 979 946 tons in the world (FAO, 2014). Not only limited to human and animal food but field pea can be used in enhancing the soil fertility by using as green (brown) for manure and as cover crops (Papnai and Singh, 2011). In developing countries like Bangladesh, animal source of protein being expensive, plant protein source can be a great alternative (Bitew *et al.,* 2015). It can play an

important role to overcome protein deficit. Pea is grown mainly for getting young pod and uses tender green seeds as a vegetable. The crop has gained popularity for its short duration and high nutritive value. Leaf of pea is tasty and nutritious. Pea shoots are used as a green leafy vegetable and generally are a good source of several vitamins and minerals. It also has high sugar content (12%), Vitamin A and C, calcium, phosphorus and a little bit of iron NDSU. Pea contains 86-87% of total digestible nutrients and containing 5-20% less trypsin inhibitors than soybean, which can be feed to livestock without further processing (NDSU, 2003).

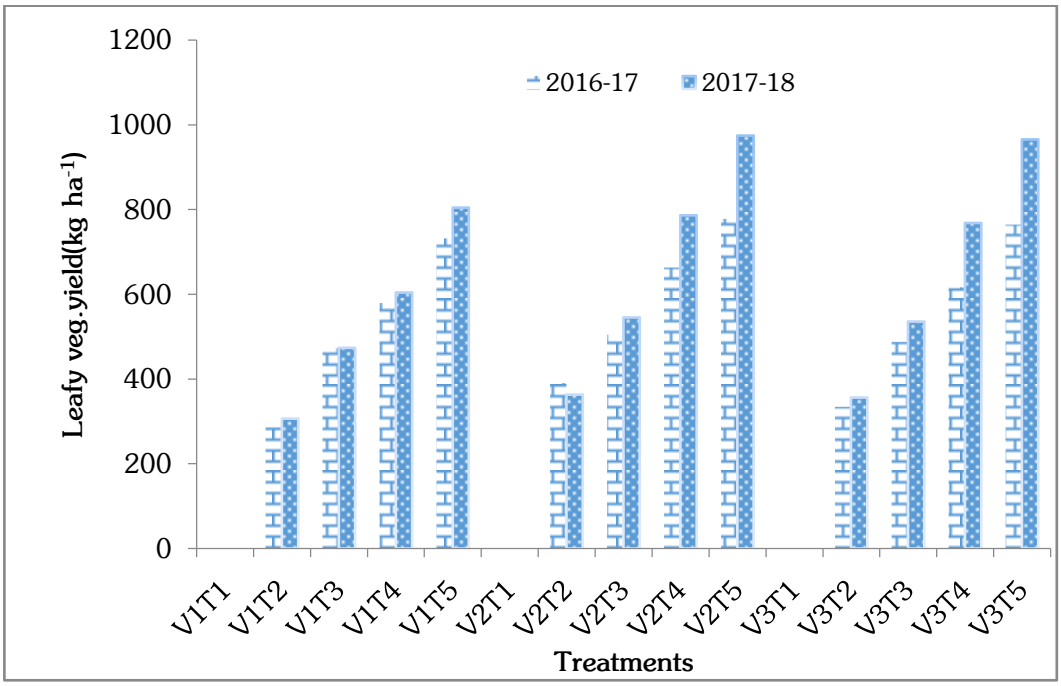
Nevertheless, it is imperative to increase productivity in different agroecological zones by manipulating various agronomic practices. Pea may produce some vegetables by clipping the growing shoot for human consumption in addition to its optimum yield. Moreover, this pruning practice could produce more branching and thereby increase pod formation. Saxena and Sheldrake (1979) and Agricar (1990) have also reported an increased chickpea yield due to clipping of the young shoot during vegetative growth. Nipping produced a higher yield compared to control treatment giving the highest return to farmers as stated by Sumarjit and Sophia (2006). Nipping is also found as an effective technique in encouraging flower production but reducing foliage production (Albert, 2009). Foliage nipping at the early stages of the crop could the increase number of branches while restricting profuse vegetative growth thereby promoting crop yield were stated by Singh and Diwakar (1995). Some farmers have been practicing shoot clipping of pea in Bangladesh especially in the Ishurdi region. Farmers not only removed twig at the vegetative stage but also twig removed at the flowering stage for vegetable purposes. But they do not follow the optimum time and length of shoot for clipping. Twig removal practice does not require any tools and equipment; it can be done by hand picking and cost-effective practice for small farmers. In this context, the investigation was undertaken to assess the effect of twig removal on the yield (pod and vegetable) and yield attributes of pea for dual purposes.

Materials and Methods

The experiment was conducted at the Research field of Agronomy Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during two successive *rabi* seasons of 2016-2017 and 2017-2018. The soil of Joydebpur belongs to the Chhiata Series under Agro-Ecological Zone-28. The soil was slightly clay loam and acidic (pH 6.1). Treatments consisted of three varieties such as V_1=Natore local, V_2= BARI Motorshuti-1 (garden pea) and V_3= BARI Motor-1 (field pea) and five twig removal variables, viz. T_1= control (no removal), T_2= removal of 5 cm twig at 25 DAE, T_3= removal of 7.5 cm twig at 25 DAE, T_4=removal of 10 cm twig at 35 DAE, T_5= removal of 12.5 cm twig at 35 DAE. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3 m× 3 m. Seeds of pea varieties were sown on 27 November in both years. Fertilizers were applied at the rate of 35-20-25-10 kg ha^{-1} of N-P-K-S (FRG, 2012) in the form of urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum. Half of the urea, the whole amount of TSP, MoP and gypsum was applied as basal. The remaining urea was top-dressed at 35 days after emergence (DAE). The fresh leafy vegetable yield was recorded as per treatment imposition and pod yield was taken from the whole plot. At a later stage of the cropping season, rust disease was visible, then @ (Tilt) 0.5 mlL^{-1} was sprayed to control it. The crop was harvested on 22 February 2017 and 27 February 2018. Data on yield and yield components were collected from the whole plot before harvest. Collected data were analyzed statistically and means were separated by $LSD_{(0.05)}$.

Results and Discussion

The yield of removed a twig as a leafy vegetable varied by the interaction of variety and twig removal of pea (Fig. 1) in both years. The maximum vegetable yield over the years (778 and 975 kg ha^{-1}) was recorded in BARI Motorshuti-1 when 12.5 cm twig removal at 35 days after emergence which was at par with that of BARI Motor-1 at the same cutting time and the same length. The lowest vegetable yield was recorded in all the varieties with twig removal of 5 cm at 25 days after emergence.



V_1=Natore local, V_2 = BARI Motorshuti-1 and V_3= BARI Motor-1and and five twig removal T_1= control (no removal), T_2= removal of 5 cm twig at 25 DAE, T_3= removal of 7.5 cm twig at 25 DAE, T_4=removal of 10 cm twig at 35 DAE, T_5= removal of 12.5 cm twig at 35 DAE

Fig. 1. Leafy vegetable yield of pea as influenced by variety and twig removal during 2016-17 and 2017-18.

Plant height, yield and yield contributing characters

Plant height, yield and yield contributing characters of pea were significantly influenced by the interaction of variety and twig removal (Table 1). Twig removal significantly reduced plant height in all the varieties. The tallest plant (98.27 cm and 110.63cm) over the years were recorded in V_1T_1 (no removal with Natore local) treatment and the shortest plant (36.10 and 38.70 cm) in V_2T_5 (twig removal of 12.5 cm at 35 DAE with BARI Motorshuti-1) over the years. These results were supported by Aslam *et al.* (2008) who explained that vigorous cutting of chickpea was positively related to the production of the tallest plants. The highest number of branches $plant^{-1}$ (3.23 and 3.35) was recorded in V_1T_3 (twig removal of 7.5 cm at 25 DAE with Natore local) treatment which was followed by V_1T_2 treatment and the lowest (1.30 in 2016-17 and 1.58 in 2017-18) was recorded in V_2T_5 (twig removal of 12.5 cm at 35 DAE with BARI Motorshuti-1). The maximum number of $podsplant^{-1}$ (12.90 and 14.30) was found in V_2T_2 (twig removal of 5 cm at 25 DAE with BARI Motorshuti-1) which was statistically similar to that of

V_2T_3 treatment while the lowest in V_3T_5 treatment (7.03 and 7.28) in both the years. An increase in auxiliary branches might be due to apical dominance exerted by the accumulation of cytokine in over auxin (Agrikar, 1990). This result indicated that there was a significant positive effect of twig removal on lateral growth and pod yield. Similar findings were observed by Saxena and Sheldrake (1979), who reported that clipping of the young shoot during vegetative growth caused an increase in auxiliary branches, which resulted in increased seed yield. Higher pod yield (9.14 tha^{-1} and 9.52 tha^{-1}) was recorded in V_2T_2 treatment which was at par with V_2T_3 treatment. Higher yields were attributed due to the cumulative effect of the number of branches $plant^{-1}$ and number of $podsplant^{-1}$. The lowest pod yield over the years (3.08 $tha^{-1}$and 3.28 tha^{-1}) was recorded in V_1T_5. These results indicated that clipping length from the tip was the main determinant influencing yield. It was observed that 5-7.5 cm length from the tip at 25 DAE was the optimum for clipping length to obtain the dual advantage of fresh leafy vegetables and pod yield. The results indicated that twig removal of 5-7.5 cm length from the tip at 25 DAE performed better as compared to other treatments in terms of pod yield along with an additional leafy vegetable. This result showed close similarity with the findings of Sumarjit and Sophia (2000). Significant reduction in the number of branches $plant^{-1}$ and pods $plant^{-1}$ was observed when 10.0 cm and 12.5 cm twig was removed from the tip at 35 DAE, which resulted in lower pod yield but provided the highest leafy vegetables. Similar results were obtained by Khan *et al.* (2006).

Table 1. Plant height, yield attributes and yield of pea as influenced by variety and twig removal during *rabi* seasons (2016-2017 and 2017-2018)

Treatment	Plant height (cm)		Branches $plant^{-1}$ (no.)		Pods $plant^{-1}$ (no.)		Pod yield (tha^{-1})	
	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018	2016-2017	2017-2018
$V_1 \times T_1$	98.27	110.63	3.16	3.19	8.27	8.86	4.31	4.63
$V_1 \times T_2$	88.70	97.70	3.20	3.33	8.51	9.04	4.48	4.76
$V_1 \times T_3$	81.00	94.00	3.23	3.35	8.35	8.78	4.38	4.56
$V_1 \times T_4$	76.73	85.97	3.17	3.23	7.85	8.08	3.29	3.74
$V_1 \times T_5$	71.30	78.97	2.80	3.15	7.04	7.58	3.08	3.30
$V_2 \times T_1$	51.03	53.37	1.41	1.70	12.80	14.16	8.32	8.55
$V_2 \times T_2$	49.17	52.50	1.60	1.74	12.90	14.30	8.62	8.84
$V_2 \times T_3$	47.27	51.27	1.66	1.76	12.47	14.05	8.33	8.68
$V_2 \times T_4$	44.83	45.83	1.54	1.67	11.11	13.02	7.27	8.01
$V_2 \times T_5$	36.10	38.70	1.30	1.58	9.76	11.67	5.93	6.58
$V_3 \times T_1$	78.07	86.07	1.47	1.62	10.67	11.01	5.10	5.25
$V_3 \times T_2$	75.50	79.20	1.48	1.66	10.32	10.82	5.12	5.46
$V_3 \times T_3$	68.30	71.63	1.52	1.71	9.98	10.45	5.04	5.28
$V_3 \times T_4$	65.70	69.03	1.44	1.62	8.05	8.28	4.22	4.74
$V_3 \times T_5$	55.97	59.30	1.31	1.59	7.03	7.28	4.04	4.24
$LSD_{(0.05)}$	5.93	7.47	0.09	0.074	0.83	0.48	0.61	0.053
CV(%)	4.95	6.78	6.61	4.53	5.10	6.23	6.55	4.05

V_1=Natore local, V_2 = BARI Motorshuti-1 and V_3= BARI Motor-1and and five twig removal T_1= control (no removal), T_2= removal of 5 cm twig at 25 DAE, T_3= removal of 7.5 cm twig at 25 DAE, T_4=removal of 10 cm twig at 35 DAE, T_5= removal of 12.5 cm twig at 35 DAE.

Cost benefits analysis

Average over the years, the highest gross return (Tk. 90311 ha^{-1}), gross margin (Tk. 57061 ha^{-1}) and benefit-cost ratio (2.72) were obtained from V_2T_2 treatment (BARI Motorshuti-1 with

twig removal of 5 cm at 25 DAE) followed by V_2T_3 treatment (BARI Motorshuti-1 with twig removal of 7.5 cm at 25 DAE). These results indicated that twig removal provided a higher gross return, gross margin, and benefit-cost ratio than that of the control (Table 2). Higher monetary returns obtained from those treatments might be due to higher yield and vegetable yield for twig removal. Similar results were also obtained by Ali *et al.* (2000) who found that the shoot picking system gave higher total production, gross return, gross margin, and benefit-cost ratio. The results revealed that twig removal of 5-7.5 cm at 25 DAE might be economically profitable for the dual purpose of pea production. It was noted that the crop was partially affected by rust disease before harvest that resulting in poor yield as well as gross margin and BCR in all treatments in the study.

Table 2. Cost and return analysis of twig removing in pea varieties (average of 2016-2017 and 2017-2018)

Treatments	Pod yield (tha^{-1})	Leafy veg. yield ($kg\ ha^{-1}$)	Gross return ($Tk.\ ha^{-1}$)	Cost of production ($Tk.\ ha^{-1}$)	Gross margin ($Tk.\ ha^{-1}$)	Benefit cost ratio
$V_1 \times T_1$	4.47	0.00	44700	27020	19680	1.65
$V_1 \times T_2$	4.62	297.11	48577	27830	23047	1.75
$V_1 \times T_3$	4.47	473.64	48489	28830	22959	1.68
$V_1 \times T_4$	3.52	592.19	39888	28960	13628	1.38
$V_1 \times T_5$	3.19	768.60	38049	28960	11789	1.31
$V_2 \times T_1$	8.35	0.00	83500	32880	50620	2.54
$V_2 \times T_2$	8.73	376.40	90311	33250	57061	2.72
$V_2 \times T_3$	8.51	525.12	89251	33250	56001	2.68
$V_2 \times T_4$	7.64	725.14	82201	32650	53551	2.52
$V_2 \times T_5$	6.26	876.83	69565	32650	40915	2.13
$V_3 \times T_1$	5.18	0.00	51750	29580	26170	1.75
$V_3 \times T_2$	5.29	345.70	55666	29960	25706	1.86
$V_3 \times T_3$	5.16	512.20	55698	31360	24338	1.78
$V_3 \times T_4$	4.48	692.92	50343	31360	18983	1.61
$V_3 \times T_5$	4.14	865.27	48322	31360	16962	1.54

V_1=Natore local, V_2=BARI Motorshuti-1 and V_3=BARI Motor-1and and five twig removal T_1=control (no removal), T_2= removal of 5 cm twig at 25 DAE, T_3= removal of 7.5 cm twig at 25 DAE, T_4=removal of 10 cm twig at 35 DAE, T_5= removal of 12.5 cm twig at 35 DAE.

Market price (Tk/kg): Fresh pod 10/-, Leafy vegetable 8/-

Conclusion

In conclusion, twig removing was found to influence significantly in enhancing the productivity of pea. Twig removing practice done before or at 30 days was found to be profitable. As twig removing plays a significant role in branching, twig removed plots gave superior results over controlled treatments. From two years study it is revealed that twig removal of 5-7.5 cm at 25 DAE of BARI Motorshuti-1 would be appropriate for obtaining higher pod yield as well as leafy vegetable yield.

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