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Impact of Topping Rapeseed (*Brassica napus* L.) On the Economic Returns under Rodh Kohi Conditions

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Abstract: Five topping stages i.e., pre-bud, bud, initial flowering stage, removal of secondary branches at initial flowering including control were studied in rapeseed cv. Westar under Rodh Kohi irrigation system of Dera Ismail Khan to determine the best topping stage which could be un-risky and profitable for fodder consumption and seed yield for the area farmers. Topping at initial flowering stage produced the maximum fodder yield (52080 kg ha^{-1}) among the treatments but the crop could not mature for seed after topping and reduced overall net return of (6%). Similarly topping at pre-bud stage also reduced the net benefit of (8%) over control. Topping at bud stage produced valuable green cut of (33500 kg ha^{-1}) considered as vegetable (Saag) by giving a maximum net return with an increase of 68% over control. Among all the treatments, crop yield slightly increased (7%) over control by giving (1531 kg ha^{-1}) yield when only the secondary branches were removed at initial flowering stage as compared to control plot yield of (1431 kg ha^{-1}). Considering the fodder value, the same treatment gave (20%) more net return over control. Plant height did not recover and maturity was delayed after topping in all the treatments.

Key words: Rapeseed (*Brassica napus*), topping stages, fodder, seed yield, economic return

INTRODUCTION

In Pakistan, rapeseed/mustard have several uses. The seed is commonly used as an oilseed. However, during early growth stages, while the crop is fresh and green, the top growth is frequently removed by topping and used or sold for fodder. Furthermore, at the bud stage, the tender shoots are frequently used as a culinary especially for people, known locally as saag (Muendel, 1990).

The family Brassicaceae includes a number of species, which have high nutritional and economic values (Saskatchewan, 1999). Among these rapeseed and mustard are important oilseed crops in Pakistan. It is the second most important source of edible oil contributing 22% of the country's domestic production (Waqar *et al*., 1991). Plucking of mustard tops for saag (leafy vegetable) and then leaving the crop to set seed is a common practice, particularly in Indo-Pakistan. Khan *et al.* (1987) reported that leaves, stem and young inflorescence of sarson and ghobi sarson are used in Pakistan and India for preparing a delicious vegetable dish known as 'saag'. These crops are grown on an area of 279.8 thousand hectares with a production of 238.1 thousand tones as 851 kg ha^{-1} on average basis (Anonymous, 2004).

A close scrutiny of the basic phonology of oilseed rape indicates that growth of the main stem and lateral branches and of their stem, flower, pods and seeds overlap significantly. It is clear; therefore, that there must be an intense competition between these organs for the available supply of assimilates especially in the 2-3 weeks after anthesis. Under normal conditions of growth and development, branches that develop in the later stages of flowering contribute little to the final seed yield of this crop. The question, then arises whether removal of the relatively less productive, lower positioned branches would stimulate the development of more productive terminal inflorescences and other apically positioned and developmentally advanced branches by making more carbon assimilates available for their growth. Labana *et al.* (1987) reported that defoliation up to 14 days before anthesis led to reduced number of flowers per plant, plant height, branch numbers, seeds per pod, seed size, seed yield, oil and protein yield. Rahmat *et al.* (2000) found that topping rapeseed (*Brassica napus* L.) cv. westar showed positive response on oil content (%) in seed in all trials which ranged 43.9 to 48.0%. Khan *et al.* (2003a) reported that topping level in wheat at tillering stage significantly reduced the plant height, spike length and grains $spike^{-1}$. Maturity was also delayed 3-5 days and the seed yield reduced 2½ fold as compared to control (un-cut), when it was topped at tillering stage. Khan *et al.* (1993) who reported in rape seed that removal of secondary branches at initial

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flowering did not generally affect seed yield but only small amount of fodder were obtained. Rahmat *et al.* (1998) found that seed yield of chickpea was significantly reduced by cutting the two months old crop at ground level but produced maximum green fodder. But the seed yield slightly increased over control, although statistically at par with control (uncut) when chickpea crop plants was ½ or 2/3 cut under rod kohi conditions. Khan *et al.* (2003 b) reported that plant height and number of branches per plant in gram were influenced by cutting levels whereas pods plant^{-1} and 1000 seeds weight did not differ significantly.

The present study was carried out to determine the best economical stage of topping rapeseed (*Brassica napus* L.) In an area where livestock is a main source of income under Rodh Kohi conditions of D.I. Khan.

MATERIALS AND METHODS

The experiment was conducted during 2003-2004 in Daman area of Rodh Kohi system of irrigation at location Kot Musa, 75 km away towards South from District D.I. Khan.

Prior to seeding, soil samples were taken from the experimental area for analysis. After the analysis, the P was found (7.0 ppm), NH_4-N (0.06 ppm), organic matter (0.72 %), pH(8.5) and soil texture was classed as silty clay loam. The mean monthly temperature and precipitation is presented in (Table 2). The fertilizer level 60-40-0 NPK kg ha^{-1} was broadcast and incorporated into the soil. The rapeseed variety Westar was planted at the rate of 5 kg ha^{-1} by a manually operated single row drill on October 17, 2003. The experiment was laid out in randomized complete block design with 3 replications and plot size of 1.8×5 m (6 rows plot^{-1}). The rapeseed crop was cut at different stages using the treatments as follows:

Topping stages

- Control
- Pre-bud stage
- Bud stage
- At first flowering stage
- Removal of secondary branches at first flowering stage

Data for green fodder and seed yield from all topping treatments was collected on the four central rows in each plot. Green fodder as forage feed valued at Rs. 0.50 kg^{-1} and food (saag) at Rs. 1 kg^{-1} and seed at Rs. 18 kg^{-1} was calculated by the time required for grass return. The topping cost, calculated by the time required for each stage multiplying labour charges of Rs. 60/person/day was subtracted from the total gross value to obtain a net value of the crop associated with each of the topping and removal of secondary branches treatments. Data were analyzed using the analysis of variance (ANOVA) procedure and LSD ($p<0.05$) values were calculated for comparisons among means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Plant Height: Plant height was significantly maximum (183.7 cm) under control plot among the treatments apart from treatment when secondary branches were taken for fodder at initial flowering stage produced plant of (175 cm) in height. This increase in plant height was mainly associated with full season duration (Table 2). Topping significantly reduced the plant height as the plant height appeared 145 cm in pre-bud, 143 cm at bud and 120 cm when the crop cut at initial flowering stage. This reduction in the plant height may be due to less number of days left after topping for plant regrowth before entering reproductive phase. Similar results were obtained by Korla and Saini (2003) who found that cutting decreased the plant height significantly.

Number of Branches: Number of branches was significantly more (7 plant^{-1}) in pre-bud and (6.7 plant^{-1}) in control which appeared at par statistically with each other (Table 1). But significantly the lowest branches (3) and (5) plant^{-1} in treatment topped at initial flowering and at bud stage which may have been the result of reduced plant growth caused by minimum duration and prevailing of high temperature (Table 1).

Days to maturity: Topping significantly lengthened the maturity of crop. It took maximum number of days (175.3) and (175.3) in the treatment topped at pre-bud and bud stage which were at par with each other. These results are in line with Khan *et al.* (1999) who concluded from the results of the experiment that all the cutting treatments reduced the yield components, seed yield and delayed the maturity of chickpea crop by effecting its physiological growth of the plant under arid condition of D.I. Khan. Similarly control (un-cut) and the treatment where only secondary branches were removed appeared at par which took 171.7 and 171.3 days to maturity. But the treatment topped at initial flowering showed very poor regrowth along with unfertile pods which could not bear seed due to higher temperature during the month of February and March imposed with dry spell after December (Table 1).

Table 1: Mean monthly temperature (°C) and monthly precipitation during 2003-2004

Month	Temperature (°C) Maximum	Minimum	Mean	Precipitation (mm)
October	34	17	25.5	--
November	27	10	18.5	--
December	23	5	14.0	29.0
January	19	4	11.5	--
February	21	6	13.5	--
March	27	11	19.0	1.5
April	35	18	26.5	29.0
Total				59.5

Table 2: Impact of topping rapeseed (*B. napus*) on seed yield

Topping stages	Plant height (cm)	No. of branches plant^{-1}	Days to maturity	1000 seed weight (g)	Seed yield (kgha^{-1})
Control	183.7a	6.7a	171.7b	7.7a	1431.0a
Pre-bud stage	144.7b	7.0a	175.3a	6.3b	685.0b
Bud stage	143.3b	5.0c	175.7a	6.5b	656.7b
Initial flowering stage	120.0c	3.0d	**	**	**
Removal of secondary branches	174.7a	6.0b	171.3b	7.7a	1531.0a
LSD≤(0.05)	20.7	0.8	1.3	0.5	509.2

Figure followed by the similar letter(s) do not differ significantly
** No seed development after topping

1000 seed weight: Seed weight was significantly reduced 6.3 and 6.5 g/1000 seeds in topping treatments of pre-bud and bud stage when highest seed weight 7.7 g/1000 seeds were recorded in control as well as in treatment where secondary branches were removed. The said treatments produced well filled lengthy pods due to utilization of plant nutrient through out the growing season. Where no seed weight was recorded in the treatment which was topped at initial flowering stage as the crop after cutting could not bear seed due to prevailing of short growing season (Table 2).

Seed yield (kg ha^{-1}): The seed yield was significantly reduced by topping in pre bud and bud stage treatments over control. But the treatment topped at initial flowering stage even did not mature for seed yield due to lesser days left for the plant to get regrowth and bear the seed. In case of removal of secondary branches, the yield was positively affected and slightly (7%) improved over control although significantly did not differ to control. This demonstrates the capability of the primary branches to compensate for potential yield by increasing yield in the remaining reproductive structures (Table 2). Ancha and Morgan (1987) also found that removal of lower positioned relatively unproductive branches in *B. napus* at anthesis, led to stronger development of the remaining inflorescences and increasing the seed yields.

Fodder yield (kg ha^{-1}): The green fodder yield ranged from 21000 kg ha^{-1} to 52080 kg ha^{-1} with topping. Topping at initial flowering stage gave maximum fodder yield (52080 kg ha^{-1}) followed by bud stage (33500 kg ha^{-1}) and pre-bud (26429 kg ha^{-1}). The lowest fodder yield (21000 kg ha^{-1}) was obtained in the treatment where only secondary branches were removed for fodder. Green fodder yield was increased according to the stage of crop topped respectively (Table 3).

Table 3: Impact of topping rapeseed (*B. napus*) on fodder production

Topping stages	Green fodder (kg ha^{-1})
Control	--
Pre-bud stage	26429bc
Bud stage	33500b
Initial flowering stage	52080a
Removal of secondary branches	21000c
LSD≤(0.05)	10600

Figure followed by the similar letter(s) do not differ significantly

Table 4: Impact of topping rapeseed (*B. napus*) on gross and net returns generated from sale of feed, food and seed

Topping stages	Values (Rs ha^{-1}) Gross value	Topping cost	Net value	Increase/ decrease over control
Control	25812.0	-	25812.0	-
Pre-bud	25544.5	1800	23744.5	- 8
Bud food (saag)[1]	45320.6	1980	43640.6	+68
Bud feed (fodder)[2]	28570.6	1980	26590.6	+3
Initial flower	26040.0	1800	24240.0	- 6
Removal of secondary branches	38058.0	6960	31098.0	+20

1: Topping sold as food/green vegetable (saag) at Rs. 1 kg^{-1}, 2: Topping sold as feed/fodder at Rs. 0.50 kg^{-1} as also for other topping treatments seed valued Rs.18 kg^{-1}

Gross return ha^{-1}: Rapeseed (*Brassica napus* L.) showed a great fodder potential, when it was topped for fodder value. It produced a maximum gross return over control but its increase trend was gradually increased according to its stage of topping. The maximum gross return of Rs. 45321 ha^{-1} was obtained from treatment topped at bud stage, sold as a (saag) at 50% higher rate over another topping followed by treatment where only secondary branches were removed appeared with an Rs. 38058 ha^{-1}. This observation agrees with the work reported by Rahim (1986), who found that the cutting treatment of rapeseed before flower bud formation was more profitable, giving 25% more income than the uncut treatment. Leaves from this cut were used as vegetable or fodder. The lowest gross return of Rs. 25544.5 ha^{-1} was obtained from pre bud treatment amongst all the topping treatments including control (Table 4).

Net return ha^{-1}: Similarly to gross return, the highest net return Rs 43340.6 ha^{-1} was produced from treatment topped at bud stage and sold its green cut as a saag which gave an increase of 68% whereas 3% when it green cut was sold as fodder followed by treatment where secondary branches were removed appeared with a net

value of Rs 31098 ha^{-1} and an increase of 20% over control treatment (Table 4) These results are in conformity with Gupta and Saini (1986) who reported that ghobi sarson plucked once for saag at 50-60 days after sowing followed by seed setting gave better returns than those from un-plucked.

The net value in the topping at pre bud and first flowering stage was reduced 8% and 6% respectively over control which may have been the result of lower fodder/seed yield with early pre bud topping and no seed bearing after topping the crop at first flowering stage as shown in Table 4.

CONCLUSION

- The present study concluded that canola type rapeseed performs better for fodder production under Rodh Kohi conditions.
- Topping at initial flowering stage can be used only for fodder but not for seed production because the crop fail to develop seeds after topping due to short growing period and prevailing of high temperature during critical stages of plant development.
- Removal of secondary branches at initial flowering stage did not reduce the seed yield, gave a small amount of fodder with an increase of 20% over control but was time consuming hence costly.
- Thus topping rapeseed at bud stage produced maximum net return of 68% over control when sold as a green vegetable/saag.

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