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DUAL PURPOSE CANOLA: GRAZING AND GRAINS OPTIONS

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ABSTRACT

Dual purpose canola can be a viable option to provide sufficiently high quality forage to livestock in the shortfall period during the months of December and January along with seeds. A field experiment was conducted at New Developmental Farm (NDF) of the University of Agriculture Peshawar Pakistan during winter 2013-14. The aims of the experiment were to study the effects of grazing on yield, yield components, biomass accumulation and weed biomass of canola and to evaluate grazing as an option in canola. The results indicated number of plants at harvest were large in ungrazed plots as compared to grazed plots however, branches plant^{-1} were not affected by grazing. Yield and yield components were greatly suppressed by grazing. Pods pod^{-1}, grains pod^{-1}, thousand grain weight, grain yield, biological yield were significantly higher in ungrazed plots as compared to grazed plots. Similarly, plants were taller in ungrazed plots and short in grazed plots. In contrast, grazed plots produced higher weeds fresh and dry weight as compared to ungrazed plots. It was concluded that grazing increased the weeds' biomass and decreased the yield and yield components of canola significantly.

Key words: Canola, dual purpose, grazing, weeds, yield.

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INTRODUCTION

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Canola or Brassica is grown in all the provinces of Pakistan under irrigated as well as rainfed conditions (Khan et al., 2004). Canola had an average yield of 915 kg ha^{-1} in 2012-13, average over the last five years the average yield of canola in Pakistan was 800 kg ha^{-1} (MINFA, 2014). In Khyber Pakhtunkhwa (KP), rapeseed was grown over an area of 17.1 (000) hectares with a production of 7.9 (000) tones and average yield of 450 kg ha^{-1} (MINFA, 2014). The European countries have a yield level of 3500 kg ha^{-1}, Canada 3200 kg ha^{-1} and Australia 2000 kg ha^{-1} (Reddy, 2004). Modern cultural practices and nutrient management can lead to higher yield. Apart from that, higher yielding varieties can play a significant role in increasing the total production of the country.

In Pakistan, due to harsh winter season farmers faces difficulty in obtaining green fodder for livestock. Unavailability of feed and low fodder production is the key factors on which measures should be taken to increase livestock productivity (Economic Survey, 2012-13). At the local level, food and feed safety in the region is extremely important especially in the winter (Arif *et al*., 2006).

Dual purpose canola aims at grazing the crop at vegetative stage and then letting the same crop to regrow and produce economic output. Previous studies suggested that grazing canola has a small effect on the grain yield. Timely grazing and favourable spring conditions have little effect on the grain yield of canola (Kirkegaard *et al*., 2008a). Grazing can cause delaying of development of the crop and reduces biomass, both are important in the determination of grain yield (Kirkegaard *et al.*, 2008a, b). Grain yield of canola is related with the biomass accumulation and date of flowering. If the environment is less favorable, the risk of delayed flowering and reduced biomass and yield penalty is more (Hocking and Stapper, 2001a). The timing of the initiation of flowering in canola is very important as early flowering is more suitable and is less vulnerable to frost.

Weeds compete with crop plants either for water, light, nutrients or space and hence causing serious impacts on the productivity of the crop (Shah *et al*., 2003; Roshdy *et al*., 2008; Marwat *et al.,* 2007). Growth of canola is suppressed by weeds and hence reduces the yield. The most important factor in low productivity of canola is weed density. Annual grassy weeds are controlled easily while the perennial weed requires continuous hoeing or herbicides treatments and also requires tillage which increases the production cost of the crop. Apart from yield losses it is very difficult to control the weeds in conventional canola. Due to the higher density of weeds the oil and meal quality of canola is reduced. Good weed management at the early stages (three to four weeks) after planting can have a great impact on the production and hence will be a positive point in increasing yield (Blackshaw *et al.*, 2002). *Ammi visnaga*, *Cynodon dactylon, Convolvulus arvensis, Fumaria indica*, *Coronopus didymus,* etc. were the weeds species present during the data recording of the experiment. Integrated weed management is necessary for the controlling of weeds in canola because the herbicides available for canola are very little in number.

The aims of this study were to quantify the impact of grazing on yield, yield components, biomass accumulation and weed density of canola and to evaluate grazing canola as an option.

MATERIALS AND METHODS

Experimental Site

The experimental site (34°00'43.2"N 71°28'00.4"E) was New Developmental Farm (NDF) of the University of Agriculture Peshawar, Pakistan. Peshawar is located at 34^{o}N latitude, 71^{o}E longitude and with an altitude of 315 meters above sea level and thus has a continental climate. Unlike most part of the country, Peshawar is not included in the monsoon region. Rainfall is received both in winter and in summer though erratic, non uniform and uncertain. The mean monthly maximum and minimum temperatures in summer and winter is about 40 and 18.3 ^{o}C, respectively. The relative humidity of the site varies from 46% in June to 76% in October.

Soil description

Soil of experimental site was alkaline and calcareous in nature, low in organic matter (0.845 g kg^{-1}), non-saline (EC (1:1) 0.87 d S m^{-1}) and low in available nitrogen (0.04 g kg^{-1}) and phosphorous (4 mg kg^{-1}) and near sufficient in potassium (80 mg kg^{-1}). The texture of the soil was silty clay loam (sand 8.7%, silt 51.3% and clay 40%) with a pH of 8.02. Canal water was available for irrigation (Ali *et al.*, 2015).

Experimental details

A field experiment was conducted at New Developmental Farm of the University of Agriculture Peshawar Pakistan during winter 2013-14. The aim of this experiment was to study the effects of grazing on yield, yield components, biomass accumulation and weeds' biomass of canola and to evaluate grazing as an option in canola. The experiment was laid out in randomized complete block design with five replications. Canola variety Abasin-95 was sown in rows 50 cm apart in five fields each having an area of half acre. Half of each canola field was grazed 70 days after sowing at random by cows from nearby dairy farm while remaining half of the five fields were left un-grazed, considering each as a replicate. Basal dose of nitrogen and phosphorus was applied to all fields at the rate of 90:60 kg NP ha^{-1} from urea and DAP, respectively. Other agronomic cultural practices were adopted uniformly throughout the growing season. Data were recorded on number of plants at harvest, plant height, branches plant^{-1}, grains pod^{-1}, thousand grains weight, grain yield, biological yield and weeds fresh and dry biomass.

Procedure for data recording

Plant height data were recorded by taking the height of ten randomly selected plants from ground level to the tip of the plant in each sub plot at physiological maturity and then their average was calculated. For the number of branches plant^{-1}, ten plants were randomly selected from each sub plot, tagged and then the number of branches in each plant was counted. Data regarding seeds pod^{-1} were recorded by counting the number of seed in ten randomly selected pods in each sub plot and then averaged. Thousand seed were counted at random from the plot yield of each treatment and were weighed to record 1000 seed weight in gram. Biological yield was calculated after harvesting three central rows in each plot, sun dried and weighed with a top load balance and then converted to kg ha^{-1}. For seed yield, three central rows in each sub plot were harvested, dried and the seed was weighed with an electronic balance and then converted to kg ha^{-1}. For calculating plants at harvest, data were recorded by counting plants in each subplot in central five rows and then converted to plants m^{-2}. Data regarding weeds fresh and dry biomass was calculated with the help of quadrate of size 2m x2m in three different places at each treatment plot and then weighted with the help of digital balance. A sample of one kg was taken from each treatment plot and oven dried at 100 C^{0} for 48 hour and then the weeds dry weight was measured with the help of digital balance

Statistical analysis

Data recorded were analyzed according to method suitable for randomized complete block design. Means were separated using LSD test when F test was significant (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Data on plants m^{-2}, yield and yield components, plant height and weeds fresh and dry weight of dual purpose are given in Table-1. Higher number of plants at harvest was recorded in ungrazed plots as compared to grazed plots. There was no significant difference between grazed and ungrazed plots for branches plant^{-1}. Yield and yield components were higher in ungrazed plots in comparison with grazed plots. Pods pod^{-1}, grains pod^{-1}, thousand grain weight, grain yield, biological yield were higher in ungrazed plots as compared to grazed plots. Similarly, taller plants were measured in ungrazed plots and short stature plants were recorded in grazed plots. In contrast, weeds biomass was higher in grazed plots as compared to ungrazed plots.

Weeds fresh and dry weights were higher in grazed plots as compared to ungrazed plots.

Dual-purpose cereals are usually part of mixed farming systems since ages but expanded tremendously in the recent years. Winter cereals planted till mid October produce high quality forage during fodder shortfall period of December and January (Arif *et al*., 2006). Likewise, dual purpose canola means sowing of canola a bit early than normal, grazing it by animals in fodder shortfall periods (during the months of December and January in Pakistan) and letting it to re-grow and produce grains like normal crop. Very little or almost no grazing of canola is being practiced in the country. However, a small number of farmers have previously grazed canola crops without a visible effect on yield (Kirkegaard *et al.,* 2012). Well managed dual-purpose canola can enhance the profitability by providing income from feed and seed. Dual-purpose canola can also generate similar benefits while providing a break crop for weeds and disease to clean up paddocks for subsequent cereals. In combination with grazed cereals, grazed canola can also spread the timing of operations and potentially extend the grazing window.

In this study, we evaluated the use of canola as a dual purpose crop to produce forage as well as grain for oil. Canola, being a broadleaf crop, is thought to produce abundant forage and later on grain. Our results indicated that grazing drastically suppressed plant density by causing 50% reduction in it. However, grazing did not bring any variation in branches per plant of canola. Yield and yield components were also significantly affected by grazing. Pods pod^{-1}, grains pod^{-1}, thousand grain weight, grain yield, biological yield were decreased by 33, 14, 11, 173 and 169%, respectively due to grazing. The crop was grazed just before flowering with Friesian cows which damaged the crop to large extent either by trampling or feeding on it till land level followed by a drought period of about a month time which resulted in drastic reduction in yield and yield components and biological yield. Similarly, the crop also took large time to re-grow and produce flowering. This delay in flowering may be the reason for decline in grain yield. Likewise, there was little time for the crop to produce sufficient biomass and attain good height especially when grazing was followed by drought. This drought may have terminated vegetative growth before due time which may have resulted in low biomass yield and short plants.

Reduction in seed yield of Brassica due to grazing or cutting has also been reported by Tariq *et al*. (2013) and Kirkegaard *et al.* (2012). Grazing may results in delayed flowering, buds removal or insufficient time for recovery from grazing shock and ultimately low biomass and seed production (Kirkegaard *et al.,* 2012). The reduction in seed yield by cutting may also be due to less regenerative power of Brassica as reported by Laba *et al.* (1987).

Though, Kirkegaard *et al.* (2008a) demonstrated that with favorable spring conditions and timely grazing there was little effect of winter grazing on canola grain yield in studies near Canberra. However, grazing reduces biomass and delays development both of which are important in determining grain yield (Kirkegaard *et al*., 2008b). Grazing canola crop in a less favourable environment heightens the risk of delayed flowering and reduced biomass and grain yield of canola is closely associated with the date of flowering and biomass accumulation (Hocking and Stapper, 2001a;). Any changes in flowering date can have large consequences in yield especially in drier environments.

In this experiment, the above-ground vegetative portion of the canola crop was grazed by cows about 70 days after sowing which compelled the crop to restart its growth for biomass and yield production. This resumption of growth from almost zero did not provide sufficient time to the crop to accumulate biomass and produce yield like normal crop. The crop had already utilized most of the available nutrients during the earlier three months for biomass production and there were little nutrients available for the crop to recover from the grazing shock after grazing which resulted in delayed flowering and drastic decline in biomass yield both closely associated with final grain yield (Hocking and Stapper, 2001; Thurling, 1974; Thurling and Das, 1979).

Kirkegaard *et al*. (2008a, b) reported delayed flowering and reduced biomass due to grazing and attributed these to lower grain yield. Similarly, they further reported that grazing followed by unfavorable environment elevate the chances of low biomass production. However, Kirkegaard*et al*. (2008a, b) found that grazing canola has little effect on seed yield if followed by favorable environmental conditions. Similarly, McCormick *et al*. (2009) reported little impact of winter grazing on seed yield of canola.

In contrast, weeds biomass in terms of weeds fresh and dry weights were higher in grazed plots as compared to ungrazed plots. It may be due to open habitat for weeds after grazing of the crop. The grazing removed most of the above ground biomass of the crop and the weeds then flourished well in competition with the crop.

CONCLUSION

It is concluded from the results that grazing canola crop drastically reduced seed and biomass production. It also enhanced weeds fresh and dry weight. However, further work is needed to fully explore the possibility of dual purpose canola by growing and grazing it early to provide sufficient time for re-growth and biomass production to meet livestock fodder requirements in the fodder shortfall period.

Table-1. Effect of grazing on plants at harvest, branches plant^{-1}, pods plant $^{-1}$, grains pod^{-1}, thousand grain weight (g) and plant height (cm).

Parameters	Grazed	Ungrazed	$LSD_{(0.05)}$	CV (%)	Probability
Plants at harvest m^2	21	31	5	20	0.001
Branches plant^{-1}	9.9	11.0	2.6	24.7	0.365
Pods plant^{-1}	265	351	54	17	0.006
Grains pod^{-1}	12.4	14.1	1.4	10.1	0.019
1000 grain weight (g)	2.92	3.22	0.28	8.97	0.033
Plant height (cm)	122	167	11	8	0.000

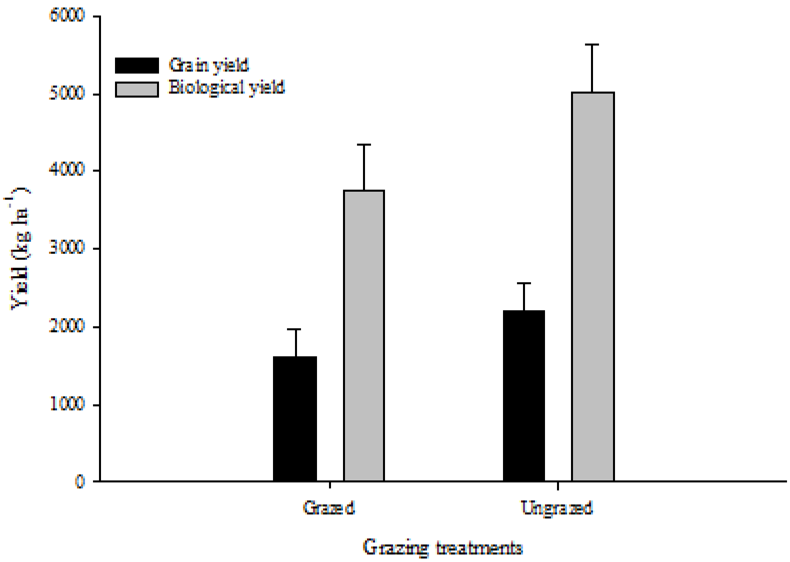

Figure 1. Effect of grazing treatments on grain and biological yield (kg ha^{-1}) of canola

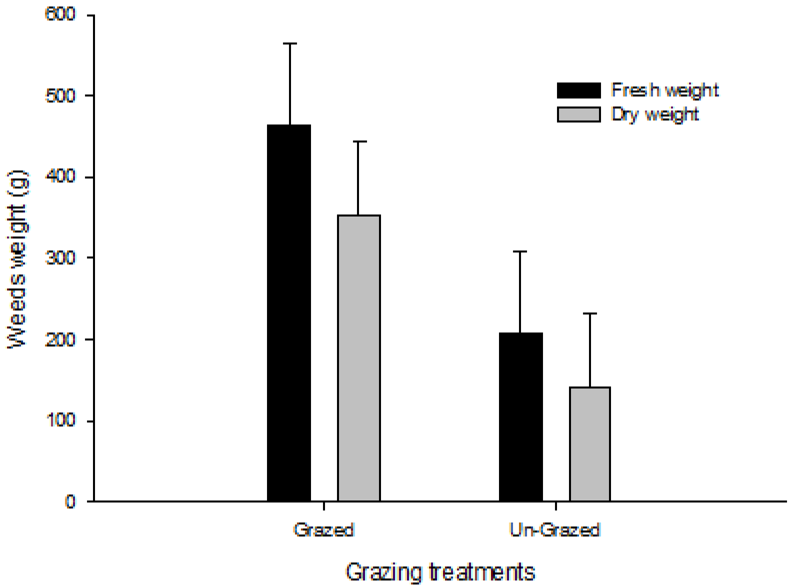

Figure 2. Effect of grazing treatments on weeds fresh and dry weight (g).

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