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Phenological Charateristics of Brassica Napus L. as Influenced by Biochar Application and Shoot Cutting Duration (Days)

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Abstract
Biochar is an organic amendment produced by a process called pyrolysis. Pyrolysis is the burning of biomass in a limited oxygen environment. In the recent past, agricultural use of biochar has been steadily increasing and attracting research interest. Biochar has been shown to reduce leaching of critical nutrients thereby providing greater soil availability and crop uptake. experiment entitled "biochar application and shoot cutting duration influenced phenology and morphology rapeseed (*Brassica napus* L) was conducted at Agriculture Research farm Matta (Swat) during *Rabi* season 2012-13. The field experiment was carried out in randomized complete block design (RCBD) having four replications. The sub plot size was kept 5 m x 2.7 m having 6 rows with 0.45 m apart. Four levels of biochar (0, 5.0, 7.5 and 10 tons ha^{-1}) and five levels of shoot cutting duration after date of sowing (ADS), (no cutting, 30 days ADS, 40 days ADS, 50 days ADS and 60 days ADS) were used in the experiment with the test cultivar Dunkled. From the results it is observed that rapeseed cultivar positively responded for days to flowering, days to maturity, number of branches $plant^{-1}$, H.I %, and maximum days to flowering (111), days to maturity (160), number of branches $plant^{-1}$ (11), number of pods per plant (172) and harvest index (14%) was observed in plot treated with 10 ton biochar ha^{-1}. Similarly highest days to maturity, number of branches per plant, (50 days ADS), and H.I (13% DAS) was noted in 50 DAS shoot cutting plot followed by shoot cutting after 60 days of sowing ADS plots while On the basis of the result it was concluded that shoot cutting with 10 ton biochar ha^{-1} produced highest branches per plant, number of pods $plant^{-1}$, harvest index and other phonological components in the agro- climatic condition of swat valley.
Keywords: Rapeseed (Brassica napus L.), biochar, ADS, shoot cutting, phenology

INTRODUCTION

Rapeseed (*Brassica napus* L.) belongs to family Cruciferae. There are 160 species concerning with *Brassica* (Holmes, 1980). Familiar species of rapeseed are *Brassica juncea, Brassica carinatea, Brassica nigra, Brassica campestris and Brassica oleracea* L. Rapeseed is a comfortable source of the edible oil. Rapeseed and mustard being traditional and conventional oil seed crop of Pakistan and are grown in all the four provinces of the country over on large area under both rain fed and irrigated situation (Khan *et al.,* 2004). In Pakistan average seed yield production of rapeseed is 812 kg ha^{-1} (MINFA, 2009), which is very low than other countries of the world. In the current agriculture, biochar is a limiting nutrient for growth and consequently to the yield production. So, N fertilization has made an unquestionable contribution to the improvement of yield and quality of crops (Havlin, *et al*. 2005). The plants obtain the biochar, mainly by the application of biochar fertilizers, industrially synthesized from the atmospheric N_2. However, due to economic as well as environmental reasons, today's challenge lies in maximizing production using the minimum possible amount of N fertilizer (Shehata, *et al.* 2004). Plants take in N as either nitrate (NO^{-3}) or ammonium (NH^{+4}) and generally grow best when both forms are available (Cramer and Lewis, 1993). Plants convert most of the N that they consume into amino acids, proteins and nucleic acids and typically contain 1– 6% N by weight (Campbell and Reece, 2002). Biochar is also an essential ingredient in the chemical structure of chlorophyll, the molecule responsible for converting light into the chemical energy that drives photosynthesis (Havlin, *et al*. 2005).Primary nutrients deficiency in rapeseed species was recognizable as a serious problem in the crop in New South Wales (NSW), Australia, in 1992, although deficiency symptoms were noticed on several occasions before that time. Since then, research has shown that the problem can be effectively diagnosed in sufficient time to enable recommendations for corrective action which is optimum doze of fertilizer application for the growing crop. Results from this research work were adopted as standard practices by over 90 percent of canola growers in NSW within 2 years. In Pakistan biochar (BC) is measured as an important nutrient and the status of biochar is not common in the soil of the country. Mohammad *et al*. (1991)concluded that N fertilization enhanced yield and yield components. Same results are also reported by Rahmatullah *et al.* (1999) while this was with the agreement of Ahmed *et al.* (1994) concluded from an experiment that application of different sources of BC fertilizers enhanced significantly seed yield of rapeseed. Biochar is the most important major elements required for the growth and development of rapeseed and to evaluate the production potential or biological crop potential of rapeseed which deserve particular attention. In view of these the entire procession, present study was conducted and evaluated the influence of BC different levels on rapeseed yield and yield contributing parameters under shoot cutting.

MATERIALS AND METHODS

To study the effect of biochar and shoot cutting on yield and quality of rapeseed cultivar an experiment was conducted at Agriculture Research farm Matta (Swat) during *Rabi* season 2012-13. Field experiment was carried out in randomized complete block design (RCBD) with four replications. Four levels of biochar (0 , 5.0, 7.5, and 10 tons ha^{-1}), and five levels of shoot cutting duration (no cut, after 30 days ADS, 40 ADS, 50 ADS and after 60 days ADS) were used in the experiment (cv Dunkled). Sub plot size was used (5 m x 2.7m) having 6 rows with 0.45 m a part. Biochar was applied at the time of seed bed preparation. Recommended dose of N was applied in the form of urea. Phosphorous was applied at the rate of 60 kg ha^{-1} in the form of SSP at the time of sowing. All the recommended agronomic practices were followed. Parameters which were studied and data was recorded were, number of seeds pod^{-1}, Thousand seed weight (g), biological yield (kg ha^{-1}), seed yield (kg ha^{-1}) and oil yield (kg ha^{-1}).

Data collected were analyzed statistically according to the procedure relevant to RCB design. Upon significant F-Test, (LSD) test was used for mean comparison to identify the significant components of the treatment means (Jan et al., 2009).

RESULTS AND DISCUSSION

Days to flowering

Mean value of the data revealed that Biochar levels and shoot cutting had significant effect on days to flowering. The interaction between Biochar levels and shoot cutting were also significant. The effect of biochar on days to flowering was significant. With increase in biochar level significant delayed were noted in days to flowering. Plots treated with different shoot cutting delayed days to flowering as compared to control plots. The interaction between Biochar levels and shoot cutting on days to flowering were also found significant with 10 ton biochar application and after 50 day of sowing, shoot cutting shows maximum (111) days to flowering. This might be due to maximum biochar application enhances vegetative growth and delayed reproductive phase. This statement are supported by Ahmadi and Bahrani (2009) who's reported the effect of Biochar levels and concluded that highest rate of application enhanced plant height, number of branches $plant^{-1}$and maximum days to flowering.

Days to maturity

Statistical analysis of data indicated that maturity of rapeseed was significantly affected by Biochar levels, shoot cutting and interaction between BC x SC were found significantly. From Mean value it was concluded that maturity was significantly delayed at application of 10 ton BC ha^{-1} and shoot cutting after 50 day of sowing (163) days while early maturity were noted in control (149) plants. In case of Biochar application levels, the plots treated with 10 tonns BC ha^{-1} taken maximum days (160) to maturity. In case of shoot cutting maximum days (161) were taken by shoot cutting after 30 day of sowing. This might be due to maximum biochar application which causes delayed flowering due to luxurious vegetative growth and ultimately delayed maturity. High cutting also reduces the potential of vegetative as well as reproductive growth. The results are supported by Kardgar, *et al.* (2010) studied the effects of different levels of N and noted that, Biochar significantly affected number of siliques $plant^{-1}$, numberof seeds $silique^{-1}$, 100-seed weight, and days to maturity.

Branches $plant^{-1}$

Mean values of the data shown that branches $plant^{-1}$ was significantly affected by Biochar levels and shoot cutting. The interaction between Biochar levels and shoot cutting were found significantly for number of branches $plant^{-1}$. Mean value indicated that maximum (11) number of branches $plant^{-1}$ were obtained at 10 tonns BC ha^{-1} while minimum (5) number of branches $plant^{-1}$ were observed in control plots. In case of shoot cutting those plots which were cut after 50 day of sowing observed maximum (10) branches $plant^{-1}$, while minimum (6) branches $plant^{-1}$ were observed in those plots which were cut after 30 day of sowing. These results also in line with those of Shehu *et al*. (2010) who reported that significantly increase in branches $plant^{-1}$and biological yield occur with increase of Biochar levels. In case of shoot cutting, More number of branches and maximum (9025 kg ha^{-1}) biological yield was recorded in those plots treated with shoot cutting after 50 day of sowing and minimum (7325 kg ha^{-1}) biological yield was noted in plots where shoot cutting was inserted after 30 day of sowing. These results were also confirmed by Khan *et al.* (2004) who stated that when secondary branches removed at the initial flowering of rapeseed they did not generally affect seed yield but only small amount of fodder were obtained.

Pods $plant^{-1}$

Analysis of data revealed that number of pods $plant^{-1}$ was significantly affected by Biochar levels and shoot cutting. The interaction between BC x SC were found significant. Mean values of data indicated that maximum (172) number of pods $plant^{-1}$ were observed in those plots which were treated at 10 tonn BC ha^{-1}, while minimum (72) in control plots. This might be due to maximum biochar enhance dry matter portioning, maximum

photosynthats, assimilation of photosynthates and ultimately increase sink capacity of the plant and as a result pods plant^{-1}increased. In case of shoot cutting, control plots have maximum (142) pods plant^{-1}and minimum (99) were observed in those plots which were cut after 30 day of sowing. The reason could be that in maximum stress condition plants cannot complete their vegetative growth and photoperiod and start early reproductive stage, struggle for to complete their life cycle and produce offspring for the survival. This might be due to high intensity of shoot cutting which reduced number of leaves through which dry matter portioning and chlorophyll contents are decreased. Similar results were reported by Malik*et al*. (2003) who reported that defoliation up to 14 days before anthesis lead to reduced seed yield.

Harvest index (%)

Statistical analysis of data regarding harvest index indicated that Biochar levels, shoot cutting and their interaction significantly affected harvest index of rapeseed. Plots received biochar was significantly higher harvest index as compared to control plots. With increase of biochar level harvest index increase significantly and therefore the highest level of biochar (10 tonns ha^{-1}) produced maximum harvest index (14%) while lowest (11%) harvest index was recorded in control plots. In case of shoot cutting maximum H.I was noted 13% at after 60 days shoot cutting. This agreed with the finding of Kardgar, *et al*. (2010) studied the effects of different levels of N and noted that, N significantly affected the number of siliques plant^{-1}, numberof seeds silique^{-1}, 100 seed weight, seed yield, oil yield, biological yield and harvest index. Shehu *et al.* (2010) also reported that significantly increase in harvest index occur with increase in biochar level. The interaction between BC x SC both biochar and shoot cutting had significant effect on harvest index. But the response of rapeseed to biochar level was more as compared to shoot cutting. Plants cut after 60 days of sowing and 10 tonns BC ha^{-1} produced maximum (14%) harvest index whereas minimum (9%) harvest index were observed in control plots treated with shoot cutting after 50 day of sowing.

Table 1: ***Days to flowering, days to maturity, No of branches plant^{-1}, number of pods plant^{-1}and harvest index % of Brassica napus L. as influenced by biochar application and shoot cutting duration***

Treatment	Days to flowering	Days to Maturity	NO of Branches	No of Pods plant^{-1}	Harvest Index %
Biochar (tonns ha^{-1})					
0	102d	149cbd	5c	72d	11b
5.0	104c	153cb	7b	126c	13a
7.5	107b	156ab	10a	163b	13a
10	113a	160a	11a	172a	14a
LSD (0.05)	1.23	6.57	1.11	4.32	1.21
Shoot cutting (cm)					
No cut	101d	152b	6bc	142c	10c
30 DAS	106bc	161a	6bc	99d	9cd
40 DAS	107b	162a	7b	123c	11ab
50 DAS	111a	163a	10a	146bc	12.5a
60 DAS	110a	163a	9a	151a	13a
LSD (0.05)	1.27	5.35	1.03	4.57	1.05
Interaction BC x SC	*	*	*	*	*

CONCLUSIONS

From present study it was concluded that *Brassica napus* L phenology significantly affected by biochar and shoot cutting duration. Maximum number of branches per plant, maximum pods per plant, days taken to flowering and to maturity and highest H I was noted with 10 tonns BC ha^{-1} as compared to control plots. Shoot cutting levels significantly affected all these parameters as compared to no shoot cutting plots. On the basis of above results it was concluded that application of biochar and shoot cutting duration enhanced the phonological traits which leads later to highest production of seeds and other contributing parameters.

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