EFFECTS OF SOWING DATES ON GRAIN YIELD AND OIL CONTENT OFRAPESEED (*Brassicacampestris var* L. *toria*) VARIETIES IN MIDDLE TERAI REGION, NAWALPARASI, NEPAL

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ABSTRACT

A field experiment was laid out in split-plot design with sowing date in the main plot and varieties in the sub-plot to determine the effects of sowing dates on growth, yield and oil content of rapeseed varieties. Four sowing dates 15 days apart set on October 13th, 28th, November 12th and 27th and four rapeseed varieties (Unnati, Preeti, Pragati and Local landrace) were used. The results revealed that the highest grain yield and oil content was obtained from the October 28th sowing date and it was statistically different from all other dates of sowing. On average, oil content was decreased by 5.75% and seed yield by 0.65 t/ha for every fortnight delay in sowing from October 28th sowing date. Highest yield and oil content was obtained from variety Preeti and it was statistically different from all other three varieties. Variety Preeti was the best yielding variety for October sowing date while variety Unnati was the best for November sowing date. Preeti is recommended to be sown on October 28th in middle terai area for optimum yield but under late sown condition, Unnati is preferred for obtaining the optimum yield.

Key words: Grain yield, oil content, rapeseed, sowing date, variety

INTRODUCTION

Oil seed crops are the third important crops of Nepal after cereals and legumes both in area and production. Oil seeds occupy about 5.87% of the total cultivated land (30,91,000 ha) of the country with a total production of 1,35,494 mt and their average productivity is about 0.747 t/ha (MoAC, 2009). The average productivity of oilseed crops in Nepal is very low as compared to that of the world average (1.28 t/ha, NORP, 2007/08). There are many crops being cultivated for oil seed purpose in Nepal, among them tori (*Brassica campestris*L. var. *toria*) is particularly important and cultivated from Terai (60 masl) to high hill (2500 masl). Agro-ecologically, Terai and inner Terai occupy 77% area of the total oil crops followed by hills with 20.6% (NORP, 2007/08).

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Among *Brassica* oil seed crops, rapeseed (*Brassica campestris* L. *var. toria*) occupies 80% of the total area under oilseed crops. Nepal was a rapeseed exporting country during 1970's, but at present the country is spending a huge amount of precious foreign exchange by importing it to bridge the wide gap between production and consumption (Ghimire, 2001, MoAC, 2009). The productivity of rapeseed has been declining for last many years as reported from various parts of the country (Chaudhary *et al.*, 1993). The growing condition changed due to climate change, nominal or no use of fertilizers, micronutrient deficiency, little attention in terms of maintaining the plant population, crop management with proper protection measures could be the major factors associated with the yield decline of rapeseed (Ghimire and Awasthi, 2000).

There is a great scope of increasing yield of rapeseed by selecting high yielding varieties and improving the management practices. Optimal time of sowing is one of the important factors for rapeseed production (Mondal and Islam, 1993). Sowing at proper time allows sufficient growth and development of a crop to obtain a satisfactory yield. The grain yield and maturity of rapeseed are greatly influenced by environmental conditions regardless of genotypes. Different sowing times provide variable environmental conditions within the same location for growth and development of crop and yield stability (Pandey *et al.*, 1981). Decreasing crop yield in delayed sowing dates has been reported by many workers (Degenhardt and Kandra, 1981; McDonald *et al.*, 1983). Hocking *et al.* (1997) in a comparison of canola, mustard and linola found a decline in oil content by 2.7% for each 1 ^{o}C rise in average temperature during grain filling stage. Detailed physiological studies have shown that water stress after flowering reduces oil content (Mailer and Cornish 1987; Champolivier and Merrien 1996). Jensen *et al.* (1996) found that oil content was 43.2% in well-watered plants and 39.9% in drought affected plants.National Seed Board (NSB) of Nepal has released a few high yield potential varieties of rapeseed. These varieties may differ in their response to sowing dates for yield, yield components and oil content. Therefore, the major objective of this study was to evaluate the effects of sowing dates and varieties on seed yield and oil content of rapeseed in the middle Terai conditions of Nepal.

METHODOLOGY

A field experiment was conducted at Tamsariya-7, Nawalparasi, Nepal during October 2009 to February 2010.The soil analysis of the experimental field at a depth of 0-20 cm was sandy loam in texture with strongly acidic in reaction (pH 4.6) and medium in total nitrogen (0.19%), available phosphorus (50.4 kg/ha) and available potassium (259 kg/ha).Four varieties Unnati (V1), Preeti (V2), Pragati (V3) and Local landrace (V4) were used to assess their

performance on four sowing dates October 13th (SD1), October 28th(SD2), November 12th(SD3) andNovember 27th(SD4). The experimental design was split-plot design with three replications assigning sowing dates as main-plot factor and varieties as sub-plot factor. The unit plot size was 2.5 x 2.4 m^2 and the crop was planted in the rows spaced 25cm with 5cm plant to plant distance. FYM (farm yard manure) was applied at the rate of 6 t/ha two weeks before sowing. The chemical fertilizer dose used for the experiment was 60:40: 20 kg/ha of NPK and S, Zn and B in the form of gypsum, $ZnSO_4$ and boric acid at 25, 5 and 1 kg/ha was applied respectively. Half of the urea and whole amount of other chemical fertilizers were applied as a basal dose in all the treatments furrows opened at a depth of 8-10 cm at the time sowing. The remaining 50% of the total dose of nitrogen was splitted in two equal halves and first halve was applied before first irrigation at initiation of flowering stage and the second halve applied before second irrigation stage at grain filling stage. Bevisteen (Carbendazim 50% WP) at the rate of 2 gm/litre of water and Roger (Dimethoate) at the rate of 2 ml/litre of water were sprayed at an interval of 10 days starting from 25 to 70 days after sowing (DAS) to control alternaria blight and aphid infestation. All other recommended practices were followed and kept uniform for all treatments.

For dry matter accumulation, five plants from four destructive rows were continuously uprooted and all leaves was detached from the main stem and packed in the envelope and placed in the electronic oven.

Envelope separately and placed in the oven for complete drying. Temperature was maintained at 70 ^oC for 72 hours for complete drying of leaves and stems (Schonfeld *et al.*, 1988). After complete drying, dry weight of the leaves and stem was taken and calculated for the individual plants.Total dry weight was calculated from summation of the leaves and stem dry weight.

Number of primary branches, number of siliqua per plant, number of grains per siliqua, siliqua length, abortion percentage, test weight and grain yield were calculated when siliquae of the crop turned brownish as an average of 10 randomly selected plants from net harvested rows per plot. Soxhlet Extraction Assembly method (Robinson, 2004) was used to estimate the crude fat of rapeseed sample. Data collected were statistically analysed by M-STATC 1997 computer program. All the analysed data were subjected to DMRT for mean comparison at 5% level of significance.

RESULTS AND DISCUSSIONS

DRY MATTER ACCUMULATION

Total dry matter production per plant at 70 DAS was significantly higher on October sowing dates compared to November sowing dates. At 70 DAS, significantly higher dry matter per plant was observed on October 13thand October 28thsowing dates and it was declined with delayed sowings. CCC

(2011) reported that at full flower stage in canola, stems become the major photosynthetic structure although leaves are still important. At the beginning of ripening, pod walls and stems account for the majority of photosynthesis while leaves make only a small contribution. Higher dry matter production per plant on October 28th sowing date compared to other dates of sowing may be due to the higher plant height and more number of siliqua per plant. Finally, there were 17.53, 36.36, and 54.8% reduction in total dry matter per plant at 70 DAS on October 13th, November 12th and November 27th sowing dates, respectively (Table 1).

Total dry matter production was significantly affected by varieties at 70 DAS of rapeseed as well. Preeti produced significantly higher dry matter compared to other three varieties. The lowest dry matter per plant was produced by Local landrace at 70 DAS and it was 33.59% lower than that of Preeti (Table 1). Plant height, leaf area index(LAI) and number of branches per plant, might be the reasons for attaining high total dry matter in Preeti compared to other varieties.

NUMBER OF BRANCHES PER PLANT

Number of branches per plant was significantly influenced by sowing dates (Table 1). The highest number of branches per plant was produced on October 28th sowing date and the lowest number on November 27th sowing date. This finding was in conformity with the findings of Shahidullah *et al.* (1997) who stated that crop sown on October 27th recorded higher number of primary and secondary branches per plant as compared to November 6th and November 16th sowing dates.

In this study, Preeti produced significantly the highest number of branches per plant which was followed by Unnati and Pragati. Similarly, Local landrace produced significantly the lowest number of branches compared to improved varieties under study.

SILIQUA PER PLANT

Sowing date had a great influence on the number of siliqua per plant, which may have apparent impact on seed yield (Table 1). The highest number of siliqua per plant was attained on October 28th sowing date. A serious reduction of siliqua per plant was noted with early as well as late sowing dates viz. October 13th, November 12th, and November 27th. This finding was in conformity with the findings of Bhuiyan *et al.* (2008) who stated that the highest number of siliqua per plant was obtained in October 30th sowing date and the lowest on November 30th sowing date.The reason for this lowering of siliqua per plant beyond November 15th sowing may be attributable to the fact that was probably fall in temperature had presumably switched plants to earlier initiation before they reached a critical size in terms of dry matter production (Scott *et al.*, 1973).

Siliqua per plant was significantly influenced by varietal characteristics. Preeti produced the highest number of siliqua per plant followed by Unnati and Pragati. Similarly, Local landrace produced the lowest number of siliqua per plant (Table 1).

SILIQUA LENGTH

Siliqua length was significantly influenced by sowing dates (Table 1). The siliqua mesasured highest in length on October 28th sowing date followe,d by October 13th and November 12th sowing dates. The lowest length of siliqua was obtained on November 27th sowing date. Afroz *et al*. (2011) found the highest siliqua length from November 10th sown crop and the lowest siliqua length from the plants of November 30th sowing date when the mustard crop was sown at 10 days interval from November 10th to November 30th.

Preeti had significantly the highest length of siliqua followed by Unnati and Pragati. The lowest length of siliqua was observed in Local landrace.

NUMBER OF SEEDS PER SILIQUA

Number of seeds per siliqua was significantly influenced by sowing dates. The highest number of seeds per siliqua was obtained on October 28th sowing date and the lowest seeds per siliqua were found on November 27th sowing date (Table 1). The result of the present investigation with respect to seed per siliqua fairly agreed with the findings of Ghose and Chatterjee (1998). They reported that delay in sowing resulted decrease in the number of seeds per siliqua in rapeseed and mustard.

Seeds per siliqua were significantly influenced by varietal characteristics as well. Preeti produced the highest number of seed per siliqua followed by Unnati and Pragati. Similarly, Local landrace produced the lowest seeds per siliqua compared to other varieties. Highest number of seeds per siliqua with Preeti might be attributed to the higher number of branches per plant, higher number of siliqua per plant and higher length of siliqua compared to other three varieties (Table 1).

Table 1. Yield attributing characters, grain yield and oil content as influenced by different date of sowing and varieties

Treatments	Dry matter (g/plant)	Branches/ Plant	SPP[1]	SL[2]	SPS[3]	Abor[4]	TW[5]	Yield t/ha	Oil Content %
Sowing dates									
SD1	10.51^{b}	2.80^{b}	54.79^{b}	5.57^{b}	10.08^{b}	21.34^{bc}	2.60^{b}	1.06^{b}	37.48^{b}
SD2	12.75^{a}	3.58^{a}	59.64^{a}	6.09^{a}	14.89^{a}	19.18^{c}	2.83^{a}	1.27^{a}	38.25^{a}
SD3	8.11^{c}	2.13^{c}	50.14^{c}	5.26^{c}	8.26^{c}	23.52^{ab}	2.16^{c}	0.76^{c}	36.56^{c}
SD4	5.76^{d}	1.4^{d}	45.49^{d}	4.19^{d}	6.12^{d}	26.85^{a}	1.91^{d}	0.48^{d}	35.39^{d}

LSD	2.23**	0.65*	4.64**	0.27**	1.01**	3.50**	0.04**	0.12**	0.20**
SEm±	0.64	0.18	1.59	0.08	0.29	1.01	0.01	0.03	0.05
Varieties									
V1	7.77^{b}	2.63^{b}	54.95^{b}	5.69^{b}	5.69^{b}	24.45^{a}	2.68^{b}	1.01^{b}	37.68^{b}
V2	8.75^{a}	3.01^{a}	72.38^{a}	6.21^{a}	6.21^{a}	21.55^{b}	2.95^{a}	1.16^{a}	39.01^{a}
V3	6.80^{c}	2.27^{c}	47.56^{c}	4.99^{c}	4.99^{c}	25.71^{a}	2.12^{c}	0.76^{c}	36.11^{c}
V4	5.81^{d}	2.00^{d}	35.16^{d}	4.21^{d}	4.23^{d}	19.19^{b}	1.76^{d}	0.64^{d}	34.88^{d}
LSD	0.96**	0.25**	4.64**	0.50**	0.50**	2.66**	0.23**	0.07**	1. 14**
SEm±	0.33	0.08	1.59	0.17	0.14	0.96	0.08	0.027	0.39
CV%	15.76	12.19	10.49	11.37	10.79	13.91	11.75	10.81	3.66

Treatments means followed by the common letter (s) within a column are non-significantly different based on DMRT at 5% level of significance.

Note: 1. Siliqua/plant 2. Siliqua length 3. Seeds/siliqua 4. Abortion 5. Test weight

TEST WEIGHT

Test weight was significantly influenced by sowing dates. The highest test weight was observed in rapeseed on October 28th sowing date and the lowest test weight observed on November 27th sowing date. It indicates that test weight is reduced with delay in sowing (Table 1). Bhuiyan *et al.* (2008) recorded that the highest test weight in rapeseed was recorded on October 30th compared to October 20th and November 10th sowings.

Test weight was significantly influenced by varietal characteristics. Preeti had the highest test weight which was followed by Unnati and Pragati. The lowest test weight was observed on Local landrace.

GRAIN YIELD

Grain yield was significantly influenced by sowing dates. The highest grain yield was observed on October 28th sowing date (Table 1, Figure 1). This might be due to higher number of branches per plant, higher number of siliqua per plant, higher number of seeds per siliqua and higher test weight of the crop sown on October 28th sowing date. On average, seed yield was decreased by 0.65 t/hafor every fortnight delay in sowing from October 28thto November sowing dates.There was17.05% reduction in grain yield for October 13th, compared to October 28th sowing date. Accumulation of higher dry matter per plant might have attributed to higher yield in October 28th sowing date compared to October 13th sowing date. Recorded yield depression on sowing dates from October 28th to November 27th may be due to the dominance of vegetative growth over the reproductive one as described by

Mendham *et al*. (1990). This finding was supported by Bhuiyan *et al*. (2008) who noted significantly higher yield on October 30th sowing date compared to October 20th, November 10th and November 30th sowing dates.

Grain yield was also significantly influenced by varietal characteristics. Preeti produced significantly the highest grain yield followed by Unnati and Pragati. Local landrace produced the lowest grain yield. The yield difference of the varieties: Unnati, Pragati and Local compared to Preeti were 12.63%, 34.14% and 44.78%, respectively (Table 1).

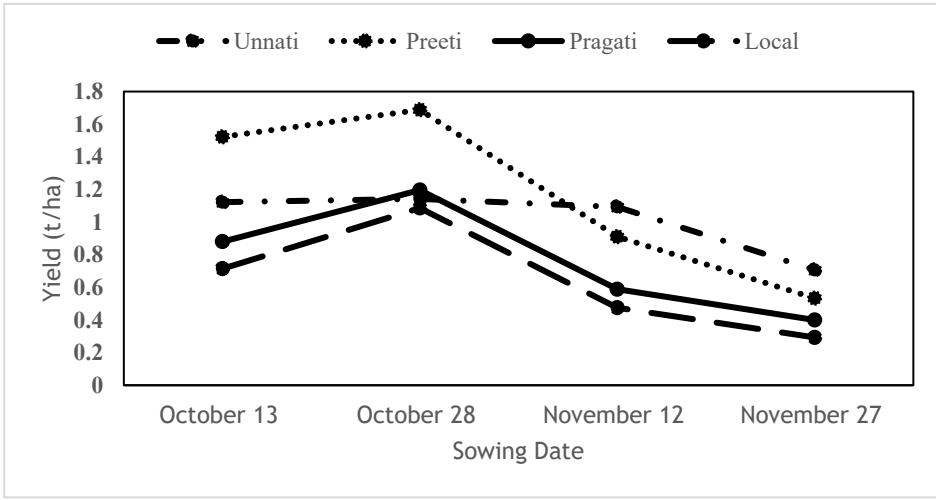

Figure 1. Interaction effect as influenced by different date of sowing date and varieties on grain yield per hectare

The interaction effect of sowing time and variety on grain yield per hectare was found significant (Figure 1). The highest grain yield of each of the variety was obtained on October 28th compared to other dates of sowing. Sowing of Preeti on October 28th produced significantly the highest seed yield. This yield was significantly higher than those obtained from Unnati, Pragati and Local. But one important aspect was noted that in November sowing dates, grain yield was significantly higher for Unnati compared to Preeti. Thus, variety Preeti was the best yielding variety for October sowing dates while variety Unnati was the best suitable for November sowing dates.

OIL CONTENT

Sowing date and variety had a significant effect on oil content (Table 1). On average, oil content was decreased by 5.75% for every fortnightly delay in sowing from October 28thto November sowing dates.The highest oil content on October 28th sowing date compared to October 13th sowing date might be attributed to the occurrence of light rainfall during the grain filling period of the crop. Si and Walton (2004) reported that oil concentration increased with

increasing post-anthesis rainfall in canola. They further reported that oil concentration increases by 0.7% with every 10 mm rainfall received after anthesis in Western Australia. The lowest oil content on November 27th sowing date might be attributed to the prevalence of higher temperature at the post-anthesis period of the crop and the lowest test weight. Oil concentration decreased with increasing post-anthesis temperature in canola and Indian mustard (Si and Walton, 2004). Similarly, Shastry and Kumar (1981) reported that reduction in test weight caused reduction in seed development with the result that the oil content in seed was reduced with a delay in sowing.

Further, the variety Preeti had the highest oil content (39.01%) followed by Unnati (37.68%), Pragati (36.11%) and Local landrace (34.88%), respectively. The lowest oil content was observed in Local landrace which was about 12% lower than that of Preeti. The highest oil content of the variety Preeti may be attributed to the higher harvest index (HI) and longer post-anthesis duration of the variety compared to other varieties (Table 1). Oil concentration increased with longer post-anthesis duration because extension of post-anthesis duration would allow pods of younger ages within a crop to have more time to grow and to accumulate oil, thus increasing oil concentration of the crops (Si and Walton, 2004). Robertson *et al*. (2004) also reported that high HI was positively associated with the high oil content in canola crop.

CONCLUSION

October 28th sowing date was found the best sowing date of rapeseed for obtaining maximum yield and oil content. The late planting of rapeseed adversely affected yield components, grain yield and oil content. Yield and yield attributes of Preeti was best for October sowing dates whereas for November sowing dates Unnati could be recommended.

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