GROWTH AND SEED YIELD RESPONSE OF SESAME VARIETIES TO SOWING DATES

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Abstract

An experiment was conducted at the Agronomy Field of Bangladesh Agricultural University, Mymensingh, during February to June 2014 to investigate the effect of dates of sowing on morphological characters, yield attributes and seed yield of sesame. The experiment comprised of three sesame varieties *viz.*, Binatil-1, BARI Til-2 and BARI Til-3 and five dates of sowing *viz*., 26 February, 13 March, 28 March, 12 April and 27 April. The experiment was laid out in a split-plot design with three replications. Results revealed that plant height, branch, leaf and node number plant^{-1}, stem, stover weight plant^{-1} and harvest index, yield attributes *viz.*, capsule number plant^{-1}, capsule length, seed number capsule^{-1}, 1000-seed weight and yield decreased with delay in sowing and yield became zero when sown in April due to death of plants at early stages due to heavy rainfall in May and June. The highest seed yield was observed when seeds were sown in 26 February due to attributed higher number of capsules plant^{-1} and seeds capsules^{-1}. The lowest seed yield was recorded in 28 March sowing. Among the cultivars, the highest seed yield was recorded in Binatil-1 (900 kg ha^{-1}). Results indicated that higher seed yield can be obtained by sowing of Binatil-1 and BARI Til-3 on 26 February while BARI Til-2 on 13 March. In contrast, the lowest seed yield was obtained in BARI Til-2 and BARI Til-3 with 28 March sowing (385 and 383 kg ha^{-1}, respectively).

Key words: Sesame, morphological characters, yield attributes.

Introduction

Sesame (*Sesamum indicum* L.) is an important oilseed in Bangladesh and is grown almost all regions in the country. It is the third largest source of edible oil in the country. Among the areas of oil crops, rapeseed/mustard, groundnut and sesame occupied 70, 18 and 12%, respectively of the total cropped area (MOA, 2015). The crop is grown both in summer and winter seasons in Bangladesh. The summer sesame covers about two-third of the total cropped area. The seeds of sesame contain 44-56% oil, 18-22% protein and 15-20% carbohydrate (Weiss, 1983). Sesame oil is mainly used for cooking and also used in the manufacture of perfumes, pharmaceuticals and insecticides (Sarker *et al.*, 2007). Hulled seed is used in baking industries. Sesame oil cake contains protein of high biological value and appreciable quantities of calcium and phosphorus and is used as animal feed and fertilizer. Oil crops play a vital role in human diet but the consumption rate is far below the balanced diet. To fulfil the requirement, the country has to increase its production to meet its internal demand. The area under oil crop may be increased for boasting its production with the adoption of appropriate technologies.

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Despite its versatile use and wide adaptability to the agro-environmental conditions of Bangladesh, the crop is still neglected both in the research and farmers levels. The climate and edaphic conditions of Bangladesh are quite suitable for its cultivation but contribution of sesame to total production is lesser due to its lower seed yield (680 kg ha^{-1}; MOA, 2015). The low yield of sesame is primarily due to poor management practices (Shubha, 2006). Successful production of the crop depends on quality seed and appropriate management practices. Among the various management practices, time of sowing is the single most important factor influencing the seed yield. Reports reveal that seed yield decreases both with delay or early planting than optimum date (Sivagamy and Rammohan, 2013). However, optimum planting time varies in different regions of Bangladesh depending upon onset of monsoon and specific photo-thermal requirement (Mondal, 2004). Research works on the effect of time of sowing on sesame are scanty. Sarkar *et al.* (2007) reported that last week of February sowing is best suited for getting maximum yield in sesame. On the other hand, Shubha (2006) reported that March sowing gave the highest seed yield in sesame. So, further research work is necessary to find out appropriate sowing date of sesame in Bangladesh. Considering the above background, the present study was undertaken to find out the effect of date of sowing on morphological characters, yield and yield attributes of sesame; and to observe the interaction effect of sowing dates and cultivars on morphological characters, yield and yield attributes of sesame.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from 26 February to 17 June 2014. The experimental field was a medium high belonging to the Sonatola Soil Series of Grey Floodplain soil under the Old Brahmaputra Floodplain Agro-ecological Zone (AEZ-9). The soil was silty loam. The experimental field is under subtropical climate characterized by heavy rainfall during the month of April to September and scanty rainfall during October to March. The maximum, minimun and average temperature range during the experimental period (February to June) are presented in Table 1.

The experiment comprised of three sesame varieties *viz.*, Binatil-1, BARI Til-2 and BARI Til-3 and five dates of sowing *viz*., 26 February, 13 March, 28 March, 12 April and 27 April. The experiment was laid out in a split-plot design with three replications. Date of sowing was assigned to main plot and variety to the sub-plot. The size of the unit plot was 3.0m × 3.0m. Plant to plant and row to row distances were maintained at 5 cm and 30 cm, respectively. Urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum and zinc sulphate were applied at 100, 130, 50, 100 and 5 kg ha^{-1} (BARI, 2014). Total amount of TSP, MoP, gypsum, borax and half of urea were applied as basal dose while remaining half urea was top dressed at 25 days after sowing. Only one weeding was done manually at 15 days after sowing for each date of sowing. Among the five dates of sowing, the later two sowing dates i.e. 12 and 27 April, the crop died before reaching harvesting stage due to

waterlogging by heavy rain. At maturity, harvesting was done only for the sowing dates of 26 February, 13 March and 28 March. Ten plants were randomly selected from each plot and tagged for recording necessary data. After sampling, the whole plot was harvested at maturity. The harvested crop was threshed, cleaned and sun-dried to a moisture content of 14% to record the seed yields and straw plot-wise and converted into tons hectare^{-1}. The collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) using the statistical computer package program, MSTAT-C (Russell, 1986).

Results and Discussion

The crop sown on 26 February, 13 March and 28 March reached maturity stage but the crops sown on 12 April and 27 April did not because they died at their vegetative stage due to heavy rain combing waterlogged condition (Table 1).

Table 1. Monthly recorded of air temperature, rainfall, relative humidity and sunshine hours of the experimental site during the period from February to June 2014

Months		Air temperature (^{0}C)			Total rainfall (mm)	Average relative humidity (%)	Total sunshine (hrs)
		Maximum	Minimum	Average			
February	01-07	24.21	13.74	18.97	0.00	80.57	6.90
	08-15	26.56	15.96	21.26	00.0	76.86	7.20
	16-22	27.00	14.81	20.91	0.10	72.00	9.06
	23-28	27.34	15.46	21.40	0.00	71.43	9.57
March	01-07	28.40	17.80	23.10	0.00	69.86	8.51
	08-15	26.50	16.40	21.45	19.0	75.63	6.63
	16-23	28.50	18.45	23.48	2.10	76.75	7.39
	24-31	29.44	20.02	24.73	92.9	78.63	7.14
April	01-07	30.41	20.33	25.37	0.00	78.86	7.46
	08-15	32.84	23.01	27.93	22.0	78.12	8.86
	16-22	30.56	22.14	26.35	51.8	82.57	6.04
	23-30	31.56	22.62	27.09	61.4	81.00	6.91
May	01-07	31.54	23.73	27.64	39.0	85.57	3.54
	08-15	32.80	23.71	28.25	20.4	77.25	7.95
	16-23	32.84	23.34	28.09	102	79.75	7.99
	24-31	32.55	23.50	28.03	104	82.50	6.29
June	01-07	32.54	24.73	28.64	35.0	87.50	5.54
	08-15	33.40	24.31	28.85	20.4	87.27	6.95
	16-23	33.84	24.54	29.19	112	79.75	7.99
	24-30	33.25	24.20	28.73	124	82.51	6.69

Source: Weather Yard, Department of Irrigation and Water Management, BAU, Mymensingh

Effect of date of sowing on morphological characters:

Results indicated that the plant height decreased with delay in sowing of all varieties (Fig. 1). The pattern of increase of plant height for the first two sowing was almost similar (Fig. 1). Although delayed sowing decreased plant height, it was very much severe for the last three sowings. The highest plant height was recorded in 26 February sowing (101.8 cm) followed by 13 March sowing (95.4 cm). The lowest plant height was observed in 27 April sowing (27.8 cm). However, at early growth stages, increased plant growth was observed under delayed sowing and finally at harvest, the plant height was shorter compared to earlier sowing. This might be related to ambient temperature and available soil moisture for plant growth and development during April sowing. It was observed that air temperature and soil moisture increased from February to May followed by no significant changes in June (Table 1). So, April sowing plants got higher air temperature and soil moisture at early growth stages compared to February and March sowing which enhanced plant growth and development. Mentionable that 12 and 27 April sowing plants died before fruit setting due to heavy rainfall causing waterlogged (Table 1). Similar result was also reported by Sarkar *et al*. (2007) in sesame where sesame plant height decreased with delayed sowing.

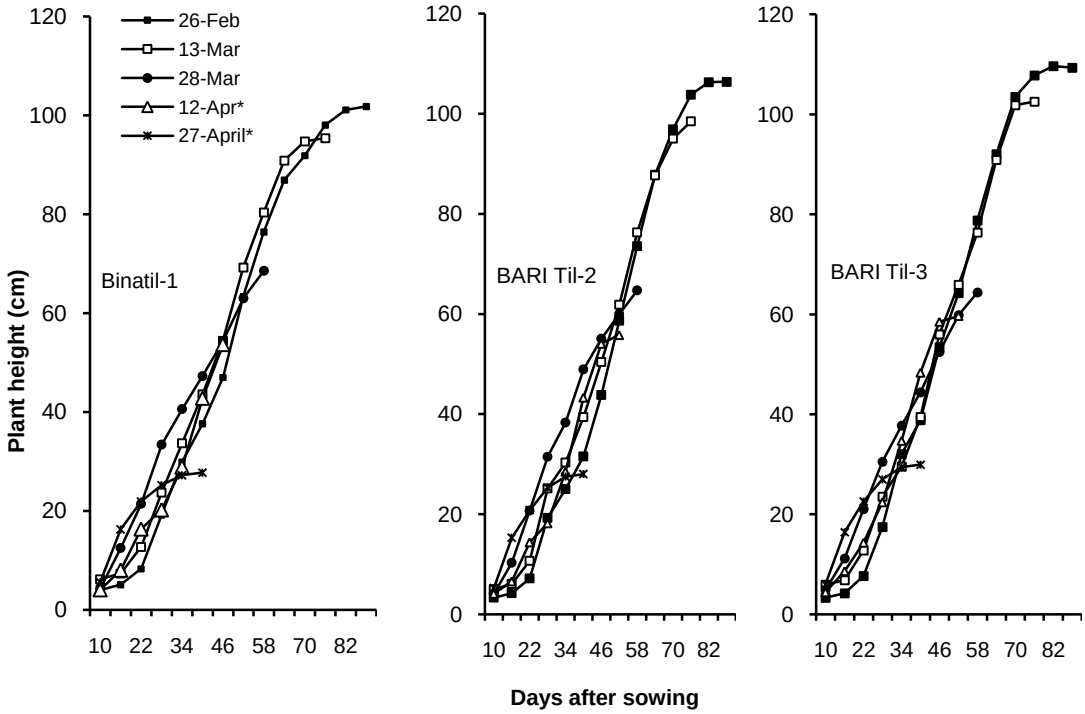

Fig. 1. Seasonal pattern of plant height of three sesame varieties *viz*., Binatil-1, BARI Til-2 and BARI Til-3 under five date of sowing. (The crop sown on 12 and 27 April died at about 40 and 60 days after sowing, respectively).

The number of leaves plant^{-1} increased slowly until 34 days after sowing (DAS) then increased rapidly up to 76-80 DAS and followed by declined at maturity (Fig. 2) due to leaf shedding. The number of leaves plant^{-1} decreased with delay sowing in all the cultivars. In Binatil-1, the highest number of leaves was recorded in 13 March sowing followed by 26 February. On the other hand, in BARI Til-2 and BARI Til-3, the highest number of leaves was recorded in 26 February sowing followed by 13 March. The lowest number of leaves plant^{-1} was observed in 27 April sowing in all the varieties. However, at early growth stages, increased leaf number was observed under late sowing compared to earlier sowing. This is because of higher plant growth and development for late sowing (Fig. 1). Similar result was also reported by Ali *et al.* (2005) in sesame.

Number of nodes plant^{-1} increased over the growing period. The highest number of nodes plant^{-1} was found in 26 February sowing then decreased with delay in sowing due to shorter plant height (Fig. 3). The highest number of nodes plant^{-1} was observed in 26 February sowing in all varieties due to production of taller plant. In contrast, the lowest number of nodes plant^{-1} was recorded in plants from 27 April sowing in all the varieties. The lower number of nodes plant^{-1} was observed in delayed sowing that might be due to its growth retardation by the heavy rainfall that might have caused root rott under saturated field condition (Sarkar *et al*., 2007). Similar result was also reported by Ghosh and Bagdi (1986) in sesame.

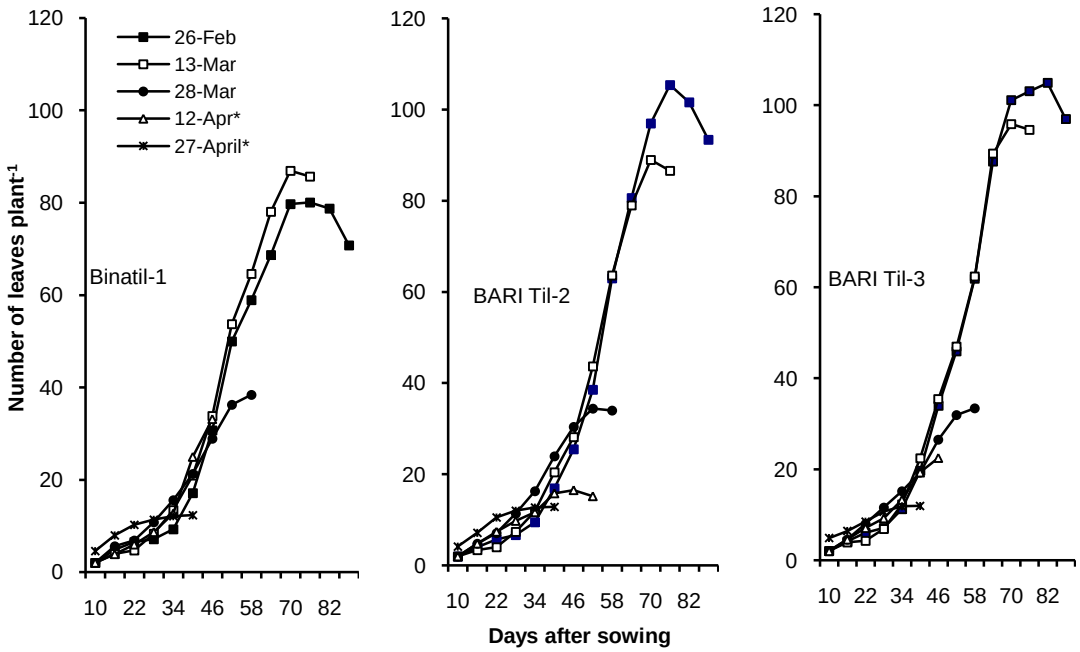

Fig. 2. Seasonal pattern of leaf production of three sesame varieties *viz*., Binatil-1, BARI Til-2 and BARI Til-3 under five date of sowing. (The crop sown on 12 and 27 April died at about 40 and 60 days after sowing, respectively).

The effect of date of sowing on stem, shell and stover weight was significant except harvest index (Table 2). Results indicated that stem, shell and stover weigh decreased with delay sowing. The highest number of branches and nodes plant^{-1} (23.55), the highest stem and stover weight was observed in 26 February sowing and the lowest was recorded in 28 March sowing (14.84) (Table 2).

Table 2. Effect of sowing date and cultivar on morpho-physiological characters of sesame

Treatments	Plant height (cm)	Nodes plant^{-1} (no.)	Branches plant^{-1} (no.)	Stem wt. plant^{-1} (g)	Shell wt. plant^{-1} (g)	Stover weight (t ha^{-1})	Harvest index (%)
Sowing date							
26 February	102.4 a	23.55 a	2.91 a	7.61 a	1.00 a	8.61 a	15.23
13 March	103.6 a	19.16 b	2.53 b	7.20 b	1.03 a	8.23 a	14.75
28 March	70.59 b	14.84 c	2.87 ab	3.11 c	0.43 b	3.54 b	13.63
Level of significance	**	**	*	**	**	**	NS
Variety							
Binatil-1 (V_1)	91.14	16.76 b	0.40 c	5.74 b	0.73 b	6.47	15.26 a
BARI Til-2 (V_2)	93.54	20.53 a	4.82 a	6.50 a	0.81 b	7.31	13.59 b
BARI Til-3 (V_3)	91.92	20.27 a	3.09 b	5.68 b	0.91 a	6.59	14.77 a
Level of significance	NS	**	**	**	**	NS	**
CV (%)	2.78	7.37	11.31	7.97	9.89	9.59	6.62

In a column, figure (s) having same letter do not differ significantly at 5% level as per DMRT;
*, ** indicate significant at 5% and 1% level of probability, respectively;
NS = Not significant; †: 12 and 27 April sowing plants died at early growth stages due to heavy rainfall.

Effect of variety on morphological characters:

The variation in number of branches and nodes plant^{-1}, stem and shell weight, and harvest index among the varieties was statistically significant except plant height and stover weight (Table 2). The highest number of nodes and branches plant^{-1}, the highest plant height, stem, stover weight was recorded in BARI Til-2 followed by BARI Til-3. The lowest number of branches and nodes plant^{-1} was observed in Binatil-1. Variation in number of nodes and branches plant^{-1} could be related to varietal characteristics. Binatil-1 produced fewer number branches plant^{-1} (Table 2) which resulted lower number of nodes plant^{-1}. Less or no branch producing plant is desirable in sesame because unicum plant has the capacity to show synchrony capsules maturation. On the other hand, branched plant shows asynchrony in capsule maturity. This is because of branches starts flowers after 70-80 % finishing of flowering by the main stem. In that context, Binatil-1 is the best variety for synchronous pod maturity. Further, harvest index indicating the efficiency of dry matter partitioning to economic yield. In the present experiment, the highest harvest index was observed in Binatil-1 which means that Binatil-1 has the better capacity to dry matter partitioning to economic yield which is the desirable character.

Effect of date of sowing on yield contributing characters and yield:

Significant effect of date of sowing was also found on seed yield and related traits (Table 3). Results revealed that total, fertile and unfertile capsule number, capsule length, number of filled and unfilled seeds capsule^{-1}, 1000-seed weight and seed yield decreased with delay sowing. The highest yield and related traits was recorded in 26 February sowing followed by 13 March sowing. In contrast, the lowest yield attributes was recorded in 28 March sowing. Mentionable that plant died when sown April or later due to heavy rainfall. Reduced number of capsules plant^{-1} under delay sowing condition might be due to production of lower number of nodes plant^{-1} (Fig. 3). Similar result was also reported by many researcher (Suryavanshi *et al.*, 1990; Sukhadi and Dhoble, 1990; Suryavanshi *et al*., 1993; Tiwari *et al*., 1994; Ali *et al*., 2005). They observed that capsule number plant^{-1} decreased with delay in sowing. The capsule length decreased with delay sowing might be due to the fact that late sown plants get less time for growth and development and had less assimilate available for capsule growth (Figs. 1-3). Here, early sown plants produced more seeds capsule^{-1} than the later sowing plants indicating early sowing helped plants to produce more assimilates which helped to set more fertile seeds capsule^{-1}. It is possible because of early sown plant has capacity to produce more leaves than the delay sowing plants (Fig. 2).

Table 3. Effect of sowing date and cultivar and their interaction on yield and related traits in sesame

Treatments	Total capsules plant^{-1} (no.)	Fertile capsules plant^{-1} (no.)	Unfertile capsules plant^{-1} (no.)	Capsule length (cm)	Filled seeds capsule^{-1} (no.)	Unfilled seeds capsule^{-1} (no.)	1000-seed weight (g)	Seed yield plant^{-1} (g)	Seed yield (kg ha^{-1})
Sowing date									
26 February (D_1)	64.71 a	46.00 a	18.71 a	2.75 a	52.09 a	22.72 a	2.60 a	4.46 a	1059.4 a
13 March (D_2)	56.13 b	46.07 a	10.98 b	2.82 a	50.00 a	16.24 b	2.32 b	3.70 b	986.94 c
28 March (D_3)	28.02 c	17.29 b	10.07 b	1.53 b	25.37 b	11.89 b	2.11 c	2.04 c	456.44 d
Variety									
Binatil-1 (V_1)	48.00 b	33.31 c	13.84 a	2.70 a	43.24 b	16.81 b	2.71 a	3.27	900.2 a
BARI Til-2 (V_2)	49.91 ab	36.44 b	13.47 a	2.54 b	49.52 a	19.49 a	2.10 b	3.53	779.1 c
BARI Til-3 (V_3)	51.04 a	40.60 a	11.44 b	1.87 c	35.70 c	14.55 c	2.21 b	3.40	823.5 c
Interaction									
D_1V_1	63.60 ab	43.33 b	20.27 a	3.52 a	55.62 bc	22.43 b	2.78	4.51 a	1141.2 a
D_1V_2	67.00 a	46.33 a	20.67 a	2.87 b	58.83 ab	26.32 a	2.41	4.43 a	890.3 c
D_1V_3	63.53 ab	49.33 a	14.20 b	1.85 d	42.81 d	19.42 c	2.54	4.43 a	1146.7 a
D_2V_1	54.40 c	42.13 b	12.00 b	2.79 b	50.15 c	15.57 d	2.74	3.55 b	957.8 c
D_2V_2	59.27 bc	49.27 a	10.00 c	3.47 a	61.49 a	18.81 c	2.05	3.84 b	1062.5 b
D_2V_3	54.73 c	47.80 a	9.93 c	2.19 c	39.37 d	14.33 de	2.17	3.70 b	940.5 c
D_3V_1	25.73 e	14.47 d	9.27 c	1.75 d	23.95 e	12.43 ef	2.59	1.75 d	601.7 d
D_3V_2	23.47 e	13.73 d	9.73 c	1.28 e	28.25 e	13.33 de	1.83	2.31 c	384.5 e
D_3V_3	34.87 d	24.67 c	10.2 c	1.57 de	24.92 e	9.92 f	1.92	2.07cd	383.2 e
CV (%)	5.34	5.58	8.08	7.90	8.03	8.81	6.27	6.77	4.93

In a column, same figure(s) do not differ significantly at $P \leq 0.05$ as per DMRT;

†: The crop sown on 12 and 27 April died at about 40 and 60 DAS due to heavy rainfall causing waterlogged condition.

This result is consistent with the result of Ali *et al*. (2005) in sesame who reported that number of filled seeds capsule^{-1} decreased with delay in sowing. Reduced 1000-seed weight for delay in sowing might be due to lower amount of assimilates translocation from leaf to capsule. Similar result was also reported by many researchers (Chimanshette and Dhoble, 1992; Sarker *et al.*, 2007; Ogundare *et al.*, 2015).

Yield was zero in April sowing due to plant died before setting capsule for heavy rainfall (Appendix II). Reduced seed weight plant^{-1} as well as seed yield (kg ha^{-1}) under late sowing condition due to lower number of capsules plant^{-1} (Table 3). Similar result was also reported by Sarker *et al*. (2007) in sesame.

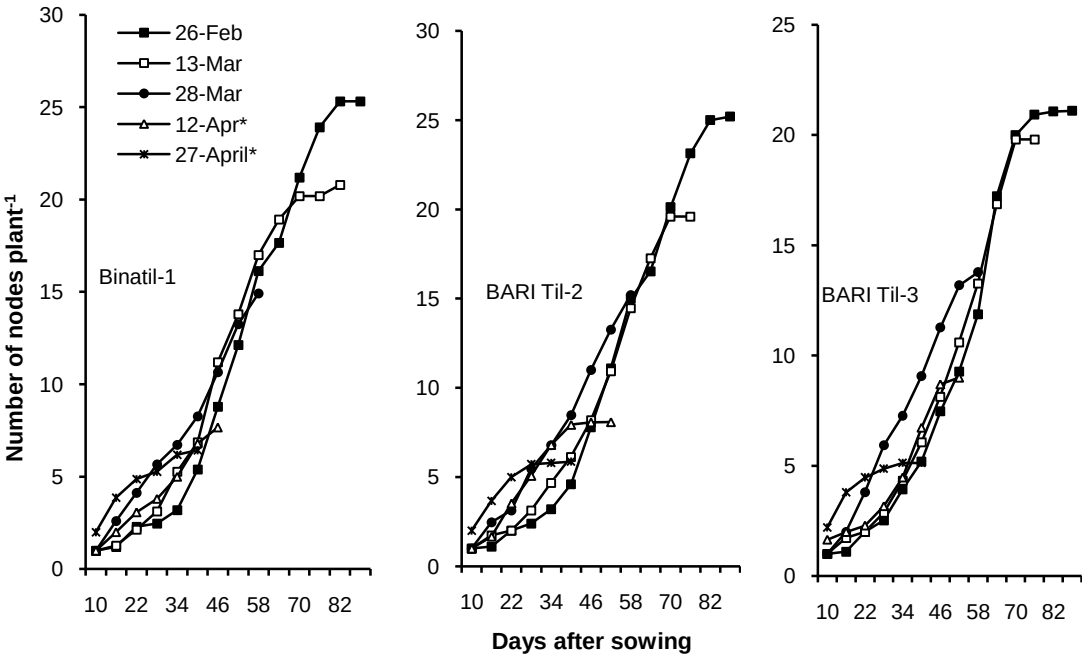

Fig. 3. Effect of date of sowing on node number at different growth stages of sesame cultivars *cv*. Binatil-1, BARI Til-2 and BARI Til-3. (The crop sown on 12 and 27 April died at about 40 and 60 days after sowing, respectively).

Effect of variety on yield contributing characters:

The effect of varieties on yield attributes and seed yield was significant except seed weight plant^{-1} (Table 3). The highest number of fertile capsules plant^{-1} was observed in BARI Til-3 with lowest number of seeds capsule^{-1} while the highest filled seeds capsule^{-1} was recorded in BARI Til-2. It is mentionable that although Binatil-1 performed inferiority in yield attributes except seed size but showed the highest seed yield per unit area basis due to greater number of plants accommodation within a unit area for its unicum canopy stature compared to BARI Til-2 and BARI Til-3. The lowest seed yield per unit area was recorded in BARI Til-2 due to smaller size seeds.

Interaction between variety and date of sowing on yield attributes and seed yield:

Interaction of sowing dates and varieties had significant effect on all yield attributes except seed size (Table 3). The highest seed weight plant^{-1} and seed yield ha^{-1} was observed in Binatil-1 when sown on 26 February (4.51 g plant^{-1} and 1141 kg ha^{-1}) which was statistically similar to BARI Til-3 × 26 February sowing (4.43 g plant^{-1} and 1137 kg ha^{-1}). In contrast, the lowest seed yield was observed in BARI Til-2 and BARI Til-3 with 28 March sowing (385 and 383 kg ha^{-1}, respectively). Results further revealed that Binatil-1 performed the best in seed yield under late sowing condition indicating Binatil-1 was more stable in producing seed yield than BARI Til-2 and BARI Til-3 under different dates of sowing from February to March.

From the results, it could be concluded that all the three varieties performed better in early sowing i.e. last week of February or first week of March followed by a decline and yield was near to zero in April sowing. Among the studied varieties, higher yield can be obtained by sowing of Binatil-1 and BARI Til-3 at 26 February while BARI Til-2 at 13 March.

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