Biological Forum – An International Journal **13(3a): 360-363(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Date of Sowing and different Levels of Irrigation on the Phenology of Mustard Cultivars

Krishna Kumar Sudhansu[1], Deb Kumar Das[2] and Joydeep Mukherjee[2]
[1]M.Sc. (Ag) Division of Agricultural Physics,
Indian Agricultural Research Institute, New Delhi -110012, India.
[2]Principal Scientist, Division of Agricultural Physics,
Indian Agricultural Research Institute, New Delhi -110012, India.

(Corresponding author: Krishna Kumar Sudhansu)*
(Received 08 July 2021, Accepted 16 September, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Indian mustard (*Brassica juncea* L.) is an important oilseed crop, grown mainly in the North-West plains of India during *rabi* season (October to March). Soil moisture deficit and terminal heat stress are common problems during growing season due to low rainfall and delayed sowing, respectively. A field experiment was conducted during the *rabi* season of 2020-21 at IARI farm with three mustard cultivars, *viz.*, Pusa Vijay, Pusa Mustard-21 and Pusa Bold in Split plot design to study the influence of irrigation levels and date of sowing on crop phenological stages/events of Indian mustard cultivars. Observations on crop Phenology were recorded twice a week at regular interval through keen observation on the field physically. The challenge during observing phenology was accounting every minute observation in the field regularly. Each date of delayed sowing progressively and significantly decreased the days taken to 50% flowering and maturity. There was delay of 15 to 20 days to attend 50 % flowering in second sown crop with respect to first sown crop but the second sown crop took 15 to 17 days less time to mature. Successive increase in irrigation levels had significant positive effect on maturity duration. The second irrigation delayed the crop maturity by one to three days in first sown crop and five to seven days in second sown crop. The rosette stage and seed filling stage were found most important phonological event in terms of irrigation applied. Pusa Bold was found to be of maximum duration among the three cultivars in both normal and late sowing conditions.

Keywords: Indian Mustard, 50 % flowering, Moisture deficiet, Pusa Bold

INTRODUCTION

Mustard or oilseed *Brassica* is an important oilseed crop next to Groundnut and its seed contains 33 to 40 per cent oil. The condiments are made from these plants' pungent seeds. The leaves and swollen leaf stems of mustard plants are also used as greens and potherbs. Indian mustard (*Brassica juncea* L.) is an important edible oil yielding crop in the group of oilseed *Brassica* accounting for about 80% of the cultivated area in North-Western (N-W) parts of India (Singh *et al*, 2014). Area wise India ranks second and in production ranks third. It is second most important oilseed crop (next to groundnut) in India. However, its productivity (<1.0 Mg ha^{-1}) is far below the world average (1.4 Mg ha^{-1}) (Hegde and Damodaran, 2000). The acreage of mustard-rapeseed crop is around 56 lakh ha, production is around 72.42 metric tons and average yield is 1980 kg ha^{-1} (DRMR, 2019) in India. This crop has also been identified as a potential oil seed crop for short season, low rainfall cropping regions in Australia (Kirk and Oram, 1978). Indian mustard is grown in *rabi* season (October to April) in N-W plains of India and subjected to various types of abiotic and biotic stresses. Phenology is the study of periodic events in biological life cycles and how these are influenced by seasonal and inter-annual variations in climate, as well as habitat factors. Phenology involves the response of living organisms to seasonal and climatic changes of the environment in which they live and phonological patterns are basic for understanding biological processes and functioning of tropical trees and ecosystems (Murray, 1909; Tesfaye *et al*., 2011). Crop phenology is a key parameter for precision farming and necessary in crop models for improving water and nutrients management in space and time. *Crop phenology* is critical for agricultural management, crop yield estimation, and agro-ecosystem assessment. Indian mustard (*Brassica juncea* L.) is a long day plant, which requires fairly cool climatic condition during growth and development for obtaining better seed yield. The different phenological stages of *Brassica* species are germination, vegetative, flowering, pod formation, seed filling, oil accumulation and maturity which are based on events like sowing, 50% emergence, 50% flowering, start of seed filling, end of the seed filling and maturity (Roy and Chakravarty, 2007; Rao, 1992; Prasad, 1989). Phenological development in the *Brassica* species is considered to be altered primarily by photoperiod, with a general shortening of phases as day length increases (Agarwal, 1971; Kumari *et al*., 1992 and Kumari *et al.*, 1994).

Mustard is normally grown on marginal and sub-marginal lands with limited irrigation. About 80% of the cropped area is characterized by erratic rains in the semi-arid zone. Even if irrigation potential is increased, Indian mustard will remain as rainfed crop because farmers prefer food crops particularly cereals under irrigated conditions. Therefore, the present investigation was under taken to find out the effect of dates of sowing and different levels of irrigation on the pattern of growth and development of Indian mustard cultivars. Menzel (2003) reported that plant phenology can be altered significantly due to global climate change because the time of development influenced by temperature both alone and by interactions with other factors. The two most important factors affecting phenological development are temperature and photoperiod (Huang *et al*., 2001; Neog *et al.*, 2005). As phenology of the crop affect the biomass and seed yield directly, it is important that phenological stage information should be known to everyone to use efficiently different management practices to increase the yield. So, present investigation was done with the objective of characterising different phenological stage and the effect of sowing date and irrigation level on the phenology of mustard crop.

MATERIALS AND METHOD

A field experiment was conducted on three different cultivars of mustard during the *rabi* season of 2020-21 (October to March).The experiment was done at the research farm of Division of Agricultural Physics of ICAR-Indian Agricultural Research Institute, New Delhi. The soils of the area are derived from Indo-Gangetic alluvium (Inceptisol order) deposits, non-calcareous, alkaline in reaction and are sandy loam in texture. The three cultivars were grown in the MB-4C field for the experiment and they were Pusa Vijay, Pusa Mustard-21 and Pusa Bold.

The two dates of sowing were selected for the experiment. The first and second dates of sowing were 30th October, 2020 and 18th November, 2020 respectively. The first date of sowing was considered as normal sowing. The second date of sowing was considered as late sowing. The design of experiment was split plot design. The three treatments were:- Main plot = Sowing dates (2), Sub plot = Irrigations (2) and Sub sub plot = Cultivars (3). The 1st irrigation was given to all the treatments at rosette (pre-flowering) stage. During seed filling stage second irrigation was given for I2 treatments for both normal (D1) and late sown (D2) crop. This second irrigation was not given to I1 treatments. Crop phenology was observed at different time interval of crop growing season. Plants from each plot were observed twice a week and different phonological stages/events were identified through keen observation. Phenological events that were identified are as follows:-(a) 50% Emergence (b) 50% Rosette (c) First flower appearance (d) 50% flowering (e) Start of pod/siliqua (f) Start of seed filling (g) End of seed filling (h) Physiological maturity (i) Harvest maturity.

RESULTS AND DISCUSSION

The cultivars were sown in two different dates of sowing. The second irrigation delayed the crop maturity by one to three days in first sown crop and five to seven days in second sown crop. The time taken to attain different phenological events was observed and presented in Tables 1 and 2. Cultivar Pusa Vijay took 6, 37, 46, 48, 51, 65, 76, 113, 123, and 140 days after sowing (DAS) to attain 50 percent emergence, 50 percent rosette, start of flowering, 50 percent flowering, start of pod development, start of seed filling, end of flowering, end of seed filling, start of senescence, and physiological maturity, respectively for 30th October sown crop (I_2D_1) (Table 1). The above mentioned phenological events were observed at 5, 36, 45, 50, 51, 64, 68, 111, 120 and 135 DAS respectively on the 30th October sown crop (I_1D_1) (Table 1).

Table 1: Time taken (days) to complete phenological events by mustard cultivars under different irrigation levels in first date of sowing.

Phenological Events	Treatments					
	D1I1V1	D1I1V2	D1I1V3	D1I2V1	D1I2V2	D1I2V3
50% Emergence	5	6	6	6	5	5
50% rosette	36	40	37	37	39	37
First flowering	45	46	45	46	47	46
50% flowering	50	54	47	48	54	48
Pod development start	51	56	52	51	57	51
Seed filling start	64	70	65	65	70	66
End of flowering	68	75	71	76	77	77
End of seed filling	111	114	112	113	115	114
Senescence start	120	123	121	123	121	123
Physiological maturity	135	136	136	140	138	140
Harvest Maturity	141	140	142	144	141	144

D_1= 30th Oct 2020,
I1-One irrigation at Rosette stage, I2- Two irrigation at Rosette and Seed filling stage,
V_1= Pusa Vijay, V_2= Pusa Mustard-21, V_3= Pusa Bold

Table 2: Time taken (days) to complete phenological events by mustard cultivars under different irrigation levels in second date of sowings.

Phenological Events	Treatments					
	D2I1V1	D2I1V2	D2I1V3	D2I2V1	D2I2V2	D2I2V3
50% Emergence	7	7	6	7	7	6
50% rosette	45	50	46	47	51	45
First flowering	59	63	60	57	58	56
50% flowering	66	73	67	66	73	64
Pod development start	68	75	68	68	75	66
Seed filling start	74	78	72	73	77	71
End of flowering	77	85	79	77	77	77
End of seed filling	100	102	101	106	107	106
Senesence start	110	113	111	108	109	109
Physiological maturity	125	124	125	127	128	128
Harvest Maturity	128	126	127	133	133	134

D2 = 18th Nov 2020,
I1-One irrigation at Rosette stage, I2-Two irrigation at Rosette and Seed filling stage,
V_1 = Pusa Vijay, V_2= Pusa Mustard-21, V_3= Pusa Bold

The above mentioned phenological events were observed at 7, 47, 57, 66, 68, 73, 77, 106, 108 and 127 DAS respectively on the 18th November sown crop (I_2D_2) (Table 2). The above mentioned phenological events were observed at 7, 45, 59, 66, 68, 74, 77, 100, 110 and 125 DAS respectively on the 18th November sown crop (I_2D_2) (Table 2) .

Cultivar Pusa Mustard-21 took 5, 39, 47, 54, 57, 70, 77, 115, 121, and 138 days after sowing (DAS) to attain 50 percent emergence, 90 percent emergence, 50 percent rosette, start of flowering, 50 percent flowering, start of pod development, start of seed filling, end of flowering, end of seed filling, start of senescence, and physiological maturity, respectively for 30th October sown crop (I_2D_1) (Table 1). The above mentioned phonological events were observed at 7, 51, 58, 67, 69, 73, 77, 107, 109 and 128 DAS respectively on the 18th November sown crop (I_2D_2) (Table 2).

Cultivar PusaBold took 5, 37, 46, 48, 51, 66, 77, 114, 123 and 140 days after sowing (DAS) to attain 50 percent emergence, 90 percent emergence, 50 percent rosette, start of flowering, 50 percent flowering, start of pod development, start of seed filling, end of flowering, end of seed filling, start of senescence, and physiological maturity respectively for 30th October sown crop (I_2D_1)(Table 1). The above mentioned phenological events were observed at 6, 45, 56, 64, 66, 71, 77, 106, 109 and 128 DAS, respectively on the 18th November sown crop (I_2D_2)(Table 2).

It can be clearly seen that there was variation in attaining different phenological stage as date of sowing vary and as level of irrigation were applied (Table 1 and 2). There was delay of 15 to 20 days to attend 50% flowering in second sown crop with respect to first sown crop. But the second sown crop took 15 to 17 days less time to mature. The second irrigation delayed the crop maturity by one to three days in first sown crop and five to seven days in second sown crop.

November sown crops were considered as late sown crops and which were subjected to low temperature stress during the vegetative period and high temperature stress during reproductive period.Exposure of vegetative stage of late sown crop to cool temperature was also reported by Roy *et al.*, (2005). The result further revealed that the vegetative stage got longer and reproductive stage got shorter in late sowing. Extension of vegetative phase and reduction in reproductive phase due to delay in sowing were also reported by Prasad (1989). The maximum crop duration (144 days) was observed in 30th October sown crop. The crop duration of 18th November sown crop (131days) was reduced considerably. The delay in sowing reduced the total crop duration also. A similar result was reported by Roy *et al.*, (2005). Not only delay sowing reduced crop duration, but reduce in irrigation frequency from two to one also reduced crop duration by 1 to 3 days in normal sowing and 2-4 days in late sowing conditions. This may be due to moisture stress suffered by crop when second irrigation was not applied in seed filling stage.

CONCLUSION

The time of sowing and different level of irrigation affect the phenology of the crop. The crop duration (emergence to harvest) reduced as there was delay in sowing and application of one irrigation instead of two irrigation. Optimum time of sowing and irrigation is necessary for proper growth and development of mustard crop.

Conflict of interest. Nil

REFERENCE

Agarwal, P.K., (1971). Effect of photoperiod on oil content, fatty acid composition and protein content of rape (*Brassica napus* L.) and flax (*Linum usitatisimum* L.) seeds. *Indian J. Exp. Biol*., **9**: 252-254.

Hegde, D. M., and Damodaran, T. (2000). Oilseeds situation. *Directorate of Oilseeds Research, ICAR, Hyderabad*.

Huang J. Z., Shrestha, A., Tollenaara, M., Deena, W., Rajcana, I., Rahimianb, H. and Swantona, C. J. (2001). Effect of temperature and photoperiod on the phonological development of wild mustard. *Field Crops Research*, **70**: 75-86.

Kirk, J. T. O., and Oram, R. N. (1978). Mustards as possible oil and protein crops for Australia [Indian mustard,

Brassica juncea, white mustard, *Sinapsis alba*]. *Journal of the Australian Institute of Agricultural Science*.

Kumar. Vinod., Sharma. H. K., Dotania. M.L., Meena. M.D and Kumar, M.S. Sujith (2018-2019). Annual report DRMR (2018-2019). http://www.drmr.res.in/

Kumari, N., Bhagava, S. C., and Bhardwaj, S. N. (1992). Physiological basis of growth in rapeseed-mustard with reference to photoperiods. *Indian Journal of Plant Physiology, 35*: 377-388.

Kumari, N., Bhargava, S. C., and Bhardwaj, S. N. (1994). Physiological basis of yield and its components in rapeseed mustard with reference to photoperiod. *Indian Journal of Plant Physiology, 37*: 142-146.

Menzel A. (2003). Plant phonological anamolies in Germany and their relation to air temperature and North atlantic oscillation. *Climate change, 57*: 243-263.

Murray, T. (1909). A new English dictionary on historical principles.7th ed. Oxford, London, 772.

Neog, P., Chakravarty, N. V. K., Srivastava, A. K., Bhagavati, G., Katiyar, R. K. and Singh, H. B. (2005). Thermal time and its relationship with seed yield and oil productivity in Brassica cultivars. *Brassica*, *7*(1): 63-70.

Prasad, R. (1989). Response of *Brassica* species to the thermal environment under Delhi conditions (Doctoral dissertation, IARI, Division of Agricultural Physics; New Delhi).

Rao, T. R. (1992). Growth and development of mustard and pearlmillet in relation to light interception and photosynthesis and modeling for *Brassica* spp. Ph.D. Thesis, I.A.R.I., New Delhi.

Roy, S., Meena, R. L., Sharma, K. C., Kumar, V., Chattopadhyay, C., Khan, S. A. and Chakravarthy, N. V. K. (2005). Thermal requirement of oilseed *Brassica* cultivars at different phenological stages under varying environmental conditions. *Indian journal of agricultural science*, *75*(11): 717-721.

Roy, Sumana and Chakravarty, N. V. K. (2007). Phenological developments and biomass partitioning in *Brassica* as influenced by weather conditions. *Journal of Agrometeorology*, *9*(2): 216 – 222.

Singh, M. P., & Singh, N. B. (2014). Thermal requirement of Indian mustard (*Brassica juncea*) at different phonological stages under late sown condition. *Indian Journal of plant physiology*, *19*(3): 238-243.

Tesfaye, G., Teketay, D., Fetene, M and Beck, E. (2011). Phenology of seven indigenous tree species in a dry Afromontane forest, southern Ethiopia. *Trop. Eco.*, *52*: 229-241.

How to cite this article: Sudhansu, K.K., Das, D. K. and Mukherjee, J. (2021). Effect of Date of Sowing and different Levels of Irrigation on the Phenology of Mustard Cultivars. *Biological Forum – An International Journal, 13*(3a): 360-363.