Journal of Crop and Weed, 13(3): 82-85(2017)

Agrometeorological indices : effect on growth and flowering behaviour in marigold

M. PREEMA DEVI, [2]L. HEMANTA, A. CHAKRABORTY AND [1]S. CHAKRABARTY

Department of Pomology and Post Harvest Technology, UBKV, Pundibari, Cooch Behar, West Bengal
[1]Department of Post Harvest Technology of Horticultural Crops, BCKV, Mohanpur, Nadia, West Bengal
[2]Department of Horticulture, SASRD, NU, Nagaland

Received : 23-03-2017 ; Revised : 08-11-2017 ; Accepted : 20-11-2017

ABSTRACT

A two year experiment was conducted on marigold, planted from January to December at one month interval to study the impact of weather on the growth characteristics of crop. Growing Degree Day (GDD) requirement showed remarkable variation during its 105 days duration; it recorded a gradual decline as the planting date was shifted from January to December. GDD requirement ranged from 2444.55 to 1524 degree days in the first year, whereas it ranged from 1869.55 to 1436.70 degree days in the second year. Plant height was significantly and positively correlated to the GDD values upto 60 days after transplanting (DAT) in the first year but upto 75 DAT in the second year. Both the plant spread and number of branch were negatively affected by the GDD significantly. Duration of flower initiation ranged from 50 to 66 days in the first year and 49 to 65 days in the second year. Flower initiation was delayed by 10-16 days when marigold was planted during May to October in both the year. This showed that the flower would come late if the marigold was planted in summer or rainy season. During flowering, Helio-thermal unit (HTU) requirement remained above 13000 day degree Celsius hour and HTU requirement was maximum when marigold was planted either in May or in October.

Keywords : GDD, HTU, marigold

Marigold (*Tagetes erecta* L.) occupies a prominent place in commercial and ornamental horticulture in West Bengal with an area of about 6.17 thousand ha and the production around 52.07 thousand mt (NHB Database, 2012). Marigold is growing throughout the year although the production doesn't remain high during the seasons of the year except October to February. The variation in the productivity is emanated from the variation in weather parameters in which the crop is grown. West Bengal experiences the tropical humid environment therefore it is highly important to identify the suitable planting times during the seasons excluding the winter. As this crop is a very popular flower and is cultivated throughout the year, the identification on planting time based on weather will be remunerative to the rural economy of Bengal. In the present experiment, we have tried to illustrate the effect of temperature, humidity and light on growth and flowering behavior in marigold.

MATERIALS AND METHODS

Three marigold varieties such as Bidhan 1, Bidhan 2 and Bidhan 3 were planted on every 4th day of each month spanning from January to December in 2011 and 2012. The size of the cutting was 6-10cm long and each cutting was treated with root promoting hormone (1000 ppm IBA). The cuttings were planted in a bed size of 1.8×1.2 m having a spacing of 30×30cm with 3 replications. The age of the cutting did not vary. All the plots received NPK@ 10:10:10 g m^2 ; half of the nitrogen, phosphorus and potash was applied as basal through urea, SSP and MOP and remaining halve of nitrogen was applied as mustard oil cake one month after planting as top dressing when earthing up was done. Soluble fertilizer N:P:K (@19:19:19)@1.5g litre^{-1} of water was sprayed on every 15 days interval. The 12th date of planting and three varieties were laid in a two factors factorial RBD for statistical analysis (Gomez and Gomez, 1984). The daily temperature, humidity and BSSH data were collected from the nearby observatory. The GDD, Heliothermal Unit were computed following the method described by Vittum *et al*. (1965) and Nath *et al*. (1999). The base temperature for winter season was assumed as 5^{0}C (October to February) and 8^{0}C (March to September).

RESULTS AND DISCUSSION

GDD indicates the thermal environment which influences crop growth. Development of different phenological phases depends on GDD as well as HTU. Marigold planted in different months recorded variation in GDD on different dates of observation. When the crop was planted in January GDD requirement for growth increased from 155.25 to 2444.55 Day Degree Celsius. During initial phase of growth (upto 60 DAT) January planted marigold recorded lower GDD than other planting dates. This might be due to low temperature in comparison to other dates of planting dates (Maximum temperature 26.5^0 C in January 2011 and minimum

Email: preema.horti@gmail.com

temperature 9.9^0 C during 15-30 DAT). The GDD significantly and positively affected plant height upto 60 DAT. Duration of flower initiation ranged from 50 to 66 days in the first year and 49 to 65 days in the second year. Flower initiation was delayed by 10-16 days when marigold was planted during May to October in both the year. This showed that the flower would come late if the marigold was planted in summer or rainy season. During flowering, helio-thermal unit (HTU) requirement remained above 13000 day degree Celsius hour and HTU requirement was maximum when marigold was planted either in May or in October.

Relationship between plant height, number of primary branches plant^{-1} and number of flowers plant^{-1}

Number of flower plant^{-1} decreased with the increment of height as it was significantly but negatively correlated (Table 1). The number of flower plant^{-1} was significantly and positively correlated with number of primary branches per plant. Increased number of primary branches in shorter plants (planted during winter months) was mainly due to less apical dominance, which facilitated the initiation of axillary bud resulting to more number of primary branches with increased plant spread (Stirnberg *et al*., 2002). The flower number would be increased with the increased branch number. Leffring (1973) reported a positive correlation between number of flowers produced and number of lateral shoots. Significant positive correlation between number of leaves and number of flowers was also reported by Suma (1993), Anuradha and Gowda (2000) and Kumar and Kumar (2001).

Impact of weather parameter on days to flowering, number of flowers per plant and size of flower

Temperature : Maximum temperature positively but insignificantly related to the days to flowering. However, both the size of flower and number of flower plant^{-1} negatively and significantly affected by maximum temperature. This implied that the rise in maximum temperature reduced the number of flower plant^{-1} and size of flower as well, but it had no significant effect on days to flowering. The minimum temperature significantly and positively affected days to flowering *i.e*. increment in minimum temperature increased the days to flowering. However, the increment in minimum temperature reduced the number and size of flowers in both the year. Summarizing the impact of maximum and minimum temperature, it can be stated that number of flower plant^{-1} and size of the flower will be decreased if maximum and minimum temperature increased (Table 2).

Relative humidity : The maximum RH (afternoon humidity) had no significant impact on days to flowering, number of flower plant^{-1} and size of flower. However, the minimum RH (morning RH) significantly and positively affected the days to flowering but negatively affected the number of flower plant^{-1} as well as size of flower.

Total rainfall: Days to flowering was positively affected by total rainfall *i.e.* opening of flower will be delayed if rainfall during the period increases. But the rainfall had no significant impact on number of flowers per plant and size of flower.

Bright sunshine hour (BSH): The bright sunshine hour, negatively and significantly affected the days to flowering. It also increased the number of flower plant^{-1} significantly. The size of flower was not affected by BSH (Table 2)

Weather parameters affect the duration to flower because of the shifting of vegetative to reproductive phase when flower induction process was entrapped because of poor stimulus, mostly in the form of heat units (Battey and Tooke, 2002).

Bidhan 1

The plants grow in an environment where the temperature and light influence its growth in a remarkable way. Variation in planting dates imposes different environment on the plant. Marigold when planted from January to December, is also subjected to varied environment (Fig. 1). Total GDD requirement gradually increased from January to March planting, it recorded a steep increase in April planting thereafter followed a gradual decline (Fig.1). The January planted crop recorded the maximum days to flower. As the planting dates were placed in February, March and April the number of days to flower reduced. The May-planted crop requires higher number of days to flower (above 50 days). June and July planted crop again required lower number of days to flower. August and September planting again required maximum days to flower. November planted crop required maximum days to flower. Armitage *et al.* (1983) indicated that the effect of sowing dates on flowering time were actually the combination of light intensity, temperature and natural photoperiod.

The above result showed that January and November planted crop required maximum days to flowers when GDD requirement was above 1000 day degree Celsius. The February, March and April planted crop required less days to flower because of increment in GDD. GDD started to decline from April and the requirement for flowering duration also found to increase slowly up to the September planted crop.

Table 1: Relationship between the number of flowers plant^{-1}, plant height and number of primary branches plant^{-1} on different dates (DAT) of observations

		Height							Branch					
		15	30	45	60	75	90	105	30	45	60	75	90	105
No. of	Correlation	-.948**	-.960**	-.959**	-.935**	-.950**	-.956**	-.949**	.966**	.990**	1.000**	.994**	.989**	.985**
flowers	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
plant^{-1}	N	12	12	12	12	12	12	12	12	12	12	12	12	12

Table 2: Impact of weather parameters on days to flowering, number of flowers plant^{-1} and size of flower in marigold planted in different months

		Temperature		Relative humidity		Total rainfall	Bright sunshine (h)
		Maximum	Minimum	Maximum	Minimum		
Days to flowering	Correlation	.496	.694*	.558	.932**	.654*	-.768**
	Sig. (2-tailed)	.101	.012	.059	.000	.021	.004
No of flower/ plant	Correlation	-.649*	-.814**	-.296	-.741**	-.573	.624*
	Sig. (2-tailed)	.022	.001	.350	.006	.051	.030
Size of flower	Correlation	-.671*	-.720**	-.078	-.588*	-.328	.400
	Sig. (2-tailed)	.017	.008	.8	.044	.298	.198

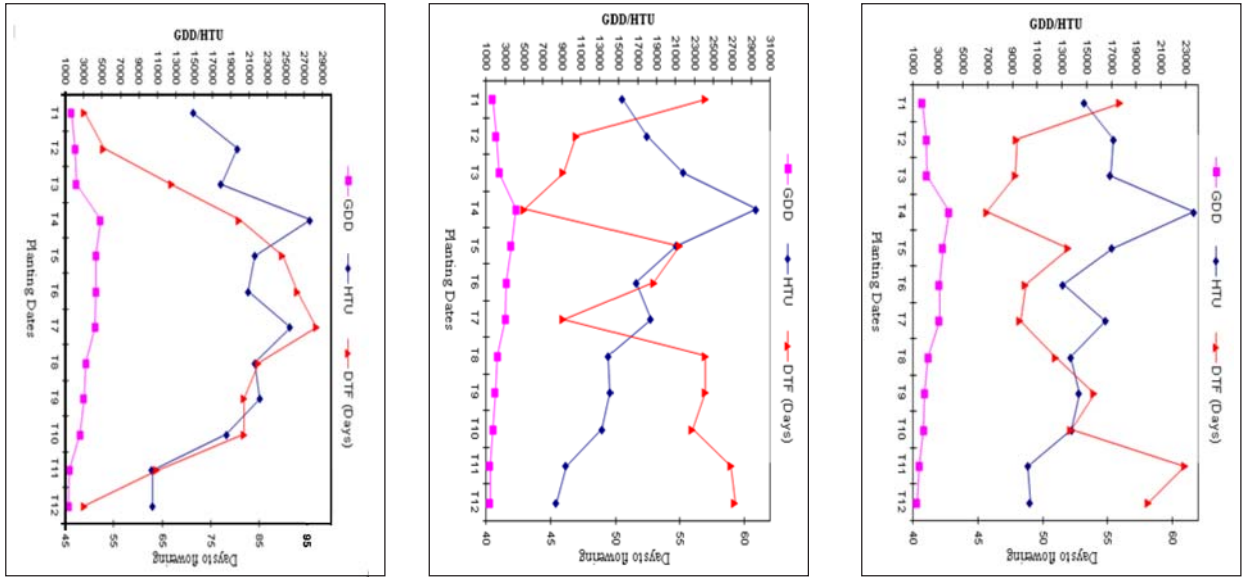

Fig. 1: Impact of GDD and HTU on days to flowering for (i) Bidhan 1, (ii) Bidhan 2 and (iii) Bidhan 3

The HTU requirement increased from January to April planting and thereafter it recorded a steep fall up to June, then again increased in July and followed a continuous fall up to December. The April planted crop required higher number of photothermal units for days to flowering. The photothermal unit requirement declined gradually from May, June and July planting.

Bidhan 2

In case of Bidhan 2 the April planted crop required minimum days to flower with maximum GDD and HTU requirement (Fig 1). The May planted crop required approximately 55 days to flower. Beyond August, the requirement for days to flower increased very slowly. The photothermal unit requirement continuously declined from April onwards.

Bidhan 3

In case of Bidhan 3, the July-planted crop required maximum days to flower (95 days). The duration of flower formation stage gradually increased from January to July planting and thereafter a steep decline was recorded (Fig 1). The HTU requirement also steeply increased from January to April and again showed a peak in July, thereafter it declined gradually.

This result suggested planting time of marigold significantly influenced the growth parameters as well as its flowering behaviour. GDD and HTU significantly explained the variation in growth and flowering behavior. In between these two agrometeorological indices, GDD is more prominent to affect the marigold than HTU, which indicated that marigold is more sensitive to thermal regime than photo-thermal regime during the growing season.

Acknowledgement

I would like to thanks Dr. P. K. Chakraborty, Retired Professor, Department of Agricultural Meteorology and Physics and Dr. R. S. Dhua, Retired Professor, Department of Post Harvest Technology of Horticultural Crops, BCKV, Mohanpur, Nadia, W.B. for their guidance during the entire research.

REFERENCES

Anuradha, S. and Gowda, J.V.N. 2000. Association of cut flower yield with growth and floral characters in gerbera. *Crop Res.,* **19**: 63-66

Armitage, A. M., Sams, C.E., Miranda, R.M., Carlson, W.H. and Flore, J.A. 1983 . The effect of quantum flux density and net photosynthetic rate on morphology and time to flower of hybrid geranium. *Scientia Hort*. **21** : 273-82.

Battey, N.H. and Tooke, F. 2002. Molecular control and variation in the floral transition. *Curr. Opinion Pl. Biol.*, **5**: 62-68.

Gomez K. A. and Gomez A.A. 1984. *Statistical Procedures in Agricultural Research*, Wiley, New York, 2nd Ed., pp. 680.

Kumar, D. and Kumar, R. 2001. Effect of modified environments on gerbera. *J. Orn. Hort. New Series*. **4**: 33-35.

Leffring, L. 1973. Flower production in gerbera. 1. Correlation between shoot, leaf and flower formation in seedlings. *Sci. Hort*., **55**: 221-29.

Nath, R., Chakraborty, P. K. and Chakraborty, A. 1999. Requirement of growing degree days. photothermal unit and heliothermal unit for different phenophase of sesame *(Sesamum indicum* L.) at different sowing dates. *Indian Agriculturist*, **43**: 127-34.

Stirnberg, P., Sande, K.V. and Leyser, H.M.O. 2002. MAX 1 and MAX 2 control shoot lateral branching in arabidopsis. *Development,* **129**: 1131-41.

Suma, P. (1993). Effect of time of planting and growth regulators on flowering and vase life of *Gerbera jamesonii*. *M.Sc. (Hort.) Thesis*, Kerala Agricultural University, Trichur, 125 p.

Vittum, M. T., Diether, B. E. and Lesser, R. C. 1965. Estimating Growing Degree Days. *Proc. Am. Soc. Hort. Sci.*, **87**: 449-52.