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Influence of Pranic Agriculture Technique on Growth and Yield of Marigold, Tagetes erecta

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ABSTRACT

Agriculture is highly mechanized and crops are grown with excess application of chemical fertilizers and pesticides which are creating environmental pollution and health problems among population. So, adaptation of ancient agriculture techniques which are supportive in achieving sustainable agriculture goals is hightly needed. Pranic agriculture (PA) is one among those ancient farming methods, which utilizes prana or life energy to obtain higher crop growth and yield with no extra inputs. Marigold is one of the most popular, multipurpose annual flowering crops cultivated in Karnataka and different parts of India. The present study was conducted to understand the influence of Pranic energy application on vegetative and reproductive traits of Marigold. Pranic energy was applied by a trained pranic healer to land and seed before sowing and to the crop at the time of growth. Experiment was carried during Kharif 2019 at farmer's field in 0.2 ha area for each treatment. Observations were recorded on different traits and data was analyzed using t-test at probability of < .05. The percent increase in plant spread of pranic treatment over control was significantly higher by 21.01% at 15 DAT, 20.49 % at 30 DAT, 17.05 % at 45 DAT, 16.38% at 60 DAT and 16.88 % at 75 DAT respectively. Number of branches were significantly higher in pranic treatment (12.6) as compared to control (11.1). The number of flowers, flower diameter and yield per plant were significantly higher in pranic treatment (72.1, 5.77cm and 587.6 g) as compared to control (58.26, 4.87cm, 449.7g) respectively. Plant growth and flower yield of marigold was enhanced by the application of pranic agriculture technique. Exact mechanism involved in the improvement of growth and yield needs to be understood. PA would be a supportive farming system in attaining sustainable and eco-friendly agriculture and improve the farmer economic status.

KEY WORDS: FLOWER YIELD, HORMONE, PLANT SPREAD, PRANA.

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INTRODUCTION

Marigold (*Tagetes erecta*. L) is a traditional, multipurpose flower cultivated throughout the world. In India, it accounts for more than half of the loose flower production. Marigold belongs to *Asteraceae* family and is grown all around the year. It is used for religious/ spiritual functions and is available in many colours like yellow and orange. Marigold flowers are used as natural

food flavour and colourant. It also contains carotenoid, which acts as an antioxidant (Narsude et al., 2010). Marigold flower extract is an ingredient in preparing ulcer curing ointment and dietary supplement in the poultry industry to enhance the chicken skin colour and egg yolk pigmentation.

Insect pest damage is one of the major threats in agriculture production (Shivakumar and Srinivasa, 2017). Different types of pesticides are applied against this, which ended in build up of resistance to insect and its residues on the crop is entering the food chain, and also causing pollution. Marigold is one of the important trap crop grown in between main crops like tomato, potato, gourds, grams and other foliage crops to control the attack of nematodes and fruit borer (Srinivasan et al., 1994). Being a multi-utility crop, there is a need to improve the flower yield in marigold.

According to Master Choa Kok Sui (Sui, 2015), Pranic agriculture is a science and art of energy treatment to the plant with "Prana". Prana refers to the energy field called bioplasmic energy surrounding living organisms like plant, animal and human. Prana is a life force or life energy which is subtle and can be observed with Kirlian's photography and is called "Aura" (Kirlian,1949). Pranic energy treatment is given externally to the plants by a pranic healer, utilising the natural prana available in sun, air, ground and water (Sui, 2015). Several studies have been conducted in crops like tomato, cucumber, pole beans, European cucumber, Drumstick, Brinjal and Papaya with pranic energy application and unparallel results were obtained in seedling vigour, plant growth, yield, antioxidant content and shelf life qualities (Jois et al., 2016; Jois et al., 2017; Yathindra et al., 2017a; Yathindra et al., 2017b; Prasad and Jois, 2019; Jois et al., 2019; Prasad and Jois, 2020).

By practising pranic agriculture, farmers can obtain additional higher yield and nutritious crop along with conventional inputs. As the pranic agriculture technique is simple to learn and practice, the farmer can get trained and practise in their field and obtain the benefits (Prasad and Jois, 2020). With these promising crop improvement results and technology access to the farmer, a study was conducted to investigate the effect of pranic energy application on plant growth and flower yield of the marigold crop. It was a first attempted pranic agriculture study on a flower crop.

MATERIAL AND METHODS

For plant material, seeds of Marigold (*Tagetes erecta* L.) Tennis ball variety was used in this study. Pranic agriculture experiment was conducted during Kharif 2019 under field condition. Each treatment was carried out in 0.2 ha land area on red loamy soil. Timely required agronomic cultural practices like weeding, irrigation and earthing up were carried out as per the package of practices. Seeds and the land were divided into two, namely control and treated (Pranic).

During Treatment, Pranic energy is applied by a trained pranic healer. Pranic energy was given for twice a week for two weeks with fifteen minutes each time to the seeds, cocopeat and land of pranic group. Cocopeat, seeds and land which did not receive any treatment were considered as control. Seeds were sown into tray pots containing cocopeat and watered regularly and grown for 20 days till the plant reaches 4 to 5 cm. Vegetative and reproductive parameters were recorded. In each treatment 25 observations were recorded at respective time intervals.

While observing the vegetative parameters, plant height (cm) and plant spread in east-west and north-south (cm^2) directions were recorded at every fortnight interval at 15, 30, 45, 60 and 75 days after transplantation (DAT) using a measuring scale. Other growth parameters like number of branches, leaf area (cm2) and root length (cm) at the grand growth stage (45 DAT) were included. Total Chlorophyll content of leaves was estimated using Dimethyl Sulphoxide (DMSO) in young leaves at 45 DAT (Shoaf and Lium,1976). Fresh leaf tissue of 100 mg was cut into small pieces and incubated in 7 ml of DMSO at 65 ^{o}C for 30 minutes. At the end of the incubation period, the supernatant was taken and made to 10 ml with DMSO, and the absorbance of the extract was read at 652 nm using DMSO as a blank. The total chlorophyll content was calculated by using the following formula and expressed on a fresh weight basis (mg g^{-1}fr.wt).

$$\text{Total chlorophyll} = 27.8\,(A_{652}) \times \frac{V}{1000 \times W \times a}$$

Where, a = Absorbance at 652 nm wavelength, V = Final volume of the chlorophyll extract (ml). W= Weight of leaf sample (g)

While observing the reproductive parameters, time of flowering and flower yield were two important reproductive parameters in marigold. Days taken for bud initiation, first flowering, 50% flowering and first harvest were recorded in both pranic and control treatments. Flower characteristics like the number of flowers per plant and flower weight (g) were recorded. Flower yield from each picking was cumulated and expressed as yield per plant (g) and yield per acre (t). Statistical analysis by t-test was carried out for vegetative and reproductive parameters using Microsoft Excel and SPSS-21.0 and the level of significance was expressed at 5% ($p< .05$). Percent difference between mean values of traits of pranic treatment over its control treatment is calculated and presented as an increase percentage.

RESULTS AND DISCUSSION

Vegetative parameters: Plant height and spread measurements were recorded at 15, 30, 45, 60 and 75 days after transplanting (DAT). Plant height and spread east-west or north-south directions are inter-related and dependent parameters (Table 1).

The difference in Plant height was non-significant among pranic and control treatments initially at 15 DAT, but interestingly as the days progress the plant height increased at a higher rate in pranic treatment. The percent change in plant height was ranging from 0.38 to 3.26 at 15 to 75 DAT. Percent increase in pranic treatment plant height was high in control initially at 15 DAT (0.38%), then increased in pranic by 1.82%, 3.0%, 3.81% at 30, 45 and 60 DAT respectively as compared to control. At 75 DAT the growth in both the treatments reduced by 3.36% as the crop growth shifted to the reproductive phase. In a similar study, Pranic treated tomato plants showed higher plant height (114.24cm) and stem diameter (16.07mm) as compared to control (92.95 cm and 14.02 mm). Pranic energy applied to tomato plant showed an increase of 18.5% and 12% in plant height and plant spread against its untreated group (Jois et al., 2016).

Table 1. Effect of pranic treatment on plant height(cm) and plant spread (cm^2).

	Treatments	Pranic		Control		Change (%)	t-stat	Critical value
		Mean	S. D	Mean	S. D			
Plant height	15 DAT	28.66	7.34	28.77	6.68	-0.38	-0.05	2
	30 DAT	35.23	7.39	34.6	6.65	1.82	0.34	2
	45 DAT	40.02	7.55	38.86	6.77	3.00	0.62	2
	60 DAT	43.00	7.64	41.42	6.80	3.81	0.84	2
	75 DAT	45.16	8.10	43.69	6.92	3.36	0.75	2
Plant spread (East- West)	15 DAT	26.96	3.01	22.28	3.58	21.01	5.48*	2
	30 DAT	30.99	3.01	25.72	3.60	20.49	6.14*	2
	45 DAT	38.59	3.09	32.97	3.44	17.05	6.65*	2
	60 DAT	42.34	3.11	36.38	3.38	16.38	7.09*	2
	75 DAT	44.24	3.22	37.85	3.48	16.88	7.37*	2
Plant spread (North- South)	15 DAT	31.01	4.34	23.37	5.07	32.69	6.27*	2
	30 DAT	35.05	4.32	26.81	5.10	30.73	6.75*	2
	45 DAT	42.64	4.24	34.06	4.62	25.19	7.49*	2
	60 DAT	46.4	4.29	37.47	4.42	23.83	7.93*	2
	75 DAT	48.29	4.32	38.94	4.64	24.01	8.07*	2
* -Significant at p< .05								

Plant spread was recorded in east–west and north–south directions during 15, 30, 45, 60 and 75 DAT. There was a significant variation between pranic and control treatments for plant spread in both directions. The mean value of plant spread in east-west direction was highest in pranic (26.96, 30.99, 38.59, 42.34 and 44.24) as compared to control (22.28, 25.72, 32.97, 36.38 and 37.85) at 15, 30, 45, 60 and 75 DAT respectively. The percent increase in plant spread (east-west) of pranic treatment over control was significantly higher by 21.01% at 15 DAT, 20.49 % at 30 DAT, 17.05 % at 45 DAT, 16.38% at 60 DAT and 16.88 % at 75 DAT respectively. The mean value of plant spread in north-south direction was highest in pranic treatment (31.01, 35.05, 42.64, 46.40 and 48.29) as compared to control (23.37, 26.81, 34.06, 37.47 and 38.94) at 15, 30, 45, 60 and 75 DAT respectively.

The percent increase in plant spread (north-south) in pranic treatment over control was significantly higher by 32.69 at 15 DAT, 30.73 at 30 DAT, 25.19 at 45 DAT, 23.83 at 60 DAT and 24.01 at 75 DAT respectively. The total number of branches are significantly higher in pranic treatment (12.6) compared to control (11.06) (Table 2). Even though leaf area and root length were non- significant between treatments, but the highest was observed in pranic treatment (108.15 and 14.02) as compared to control (103.5 and 11.26) respectively (Table 2). Total chlorophyll content was also on par in both the treatments but numerically highest in pranic treatment (3.75) as compared to control (3.42) (Table 2).

In the present study, plant height variation is non-significant between the treatments, but plant spread is significantly higher in pranic treatment. Plant growth and development and its shift from the vegetative phase to reproductive phase depend on endogenously produced plant hormones which are regulated by inherent genetic characters and external environmental influences (Gray,2004). It can be hypothesised that ratio between auxin and cytokinin might have been altered by external pranic energy treatment and have lead to the higher lateral plant spread and a higher number of branches. The well-known theory that, auxin contributes for apical dominance and cytokinin for lateral dominance and the ratio between two hormone plays a major role in branching and bud initiation in flowering plant, is parallel support for the pattern of growth in pranic treated plants (Muller and Leyser, 2011; Kebrom, 2017).

Present study results were in agreement with Bairwa and Mishra (2017), where different doses of auxin and cytokinin have shown a change in plant growth pattern in African marigold. In this study different types of

hormones viz. auxin (NAA at 100,200 and 300 ppm) and cytokinin (BA at 25, 50 and 75 ppm) and (Kinetin at 50,100 and 150 ppm) were applied at different concentrations. Among different treatments NAA @ 300 ppm recorded maximum plant height (77.26 cm), the number of branches (14.53), plant spread (60.80 ×56.86 cm2.The increase in growth and yield might be because NAA enhance cell division and expansion and tissue growth. Similar inhibition was observed in the linear growth of African marigold plant with a higher concentration of NAA (Disha et al., 2014; Kebrom, 2017).

Reproductive parameters: Flowering traits like days to bud initiation, days to first flowering, days to 50% flowering and number of days taken for the first harvest were initiated early in the pranic treated plot as compared to control plot (Table 3).

Table 2. Effect of Pranic treatment on plant morphology and chlorophyll content

Treatments	Pranic		Control		Increase (%)	t-stat	Critical value
	Mean	S.D	Mean	S.D			
Number of branches	12.6	2.39	11.06	2.39	12.22	2.48*	2
Leaf area (cm2)	108.15	10.11	103.5	5.8	4.49	0.79	2.44
Root length (cm)	14.02	3.09	11.26	2.92	24.51	1.45	2.3
Total Chlorophyll content (mg g -1fr.wt)	3.75	0.1	3.42	0.28	9.65	2.06	2.44

* -Significant at p< .05

Days taken for first flower initiation were significantly minimum in pranic treatment (64.1) as compared to control (68.26). Days for bud initiation, 50% flowering and days for first harvest were found minimum in pranic treatment (59.53, 103.5 and 91.25) as compared to control (60.86, 106 and 93.25) respectively.In a similar pranic agriculture study on pole beans (*Phaseolus vulgaris* L.), a reduction in time duration to flowering and flowering to fruit set by 2.2% and 3.2% respectively was noticed in pranic treated groups when compared to control. Mean values of flowering date and flowering to fruit set was lower in pranic treatment (30.4 and 31.2 days) as compared to control (31.1 and 32.2 days). Fruit yield of pranic treatment (0.49 kg) is higher than control (0.44 kg). The probable reason for the improvement was attributed for alterations in the molecular structure of treated cells, affect nucleotide polymerisation, gene expression and enzyme activity (Bai et al., 2000; Yathindra et al., 2017b).

Table 3. Effect of pranic treatment on flowering parameters and flower yield.

Treatments	Pranic		Control		Increase (%)	t-stat	Critical value
	Mean	S.D	Mean	S.D			
Days to bud initiation	59.53	4.89	60.86	5.32	-2.19	-1.01	2
Days to first flowering	64.1	6.58	68.26	7.86	-6.09	-2.22*	2
Days to 50% flowering	103.5	1.29	106	2.58	-2.36	-1.73	2.44
Number of days taken for first harvest	91.25	3.5	93.25	1.71	-2.14	-1.02	2.44
Number of flowers per plant	72.1	9.66	58.26	6.57	23.76	6.84*	2
Flower weight per plant (g)	8.16	0.62	7.69	0.83	6.11	1.74	2.04
Flower diameter (cm)	5.77	0.3	4.87	0.32	18.48	7.84*	2.04
Yield per plant (g)	587.6	83.34	449.7	75.46	30.68	6.72*	2
Yield per acre (t)	6.09	0.81	4.66	0.81	30.69	2.47*	2.44

* -Significant at p< .05

Cultivar Arka Bangara-2 showed minimum days to flower bud initiation (39.54), days to 50 percent flowering (51.7) and longest flower duration (77.29). Flower diameter was highest in cv. Maxima yellow (7.20 cm) followed by cv. Arka Bangara-2 (6.17 cm). The variation was attributed to the prevailing climatic condition of the experimental location. The present results are also in conformity with the findings in marigold (Narsude et al., 2010a). The number of flowers per plant, flower weight, flower diameter was found significantly higher in pranic treatment (72.1, 8.16 and 5.77) as compared to control (58.26, 7.69 and 4.87) respectively (Table 3).

Yield per plant (g) and yield per acre (t) were significantly higher in pranic treatment (587.6 and 6.09) as compared to control (449.7 and 4.66) respectively.

Similarly, Pranic agriculture study in European cucumber showed a significant reduction in time duration to flowering in pranic treatment (54.3 days) as compared to control (59.1 days). Pranic treatment showed higher yield per plant (1.9 kg/plant) as compared to control (1.58 kg/plant). This change accounts for 14 % and 18 % increase in the number of fruits per plant and higher yield in pranic treatment against its control (Yathindra et al., 2017b).

Performance of any crop is decided by its economic yield. The number of marigold flowers per plant and flower weight was found 23.76% and 6.11% higher in the pranic treated plot over and above its control.

Similarly, flower diameter and yield per plant were improved in pranic treatment by 18.48% and 30.68% over its control. Similarly, 30.69% higher yield per acre was found in the pranic plot over its control plot. A similar study on tomato plant treated with pranic energy showed higher flowers per plant (10.14) and yield per plant (117.07 kg) as compared to control (10.36 and 80.58) and this increase in number of flowers and total yield per plant accounts for 31.75% and 31.10% higher than control (Jois et al., 2016).

In another pranic agriculture study on Cucumber also showed similar results to the present study. Plant height, stem diameter and fruit yield of pranic treatment (28.77 inches, 7.45mm and 63.84 kg) as compared to control (14.60 inches, 5.65 mm and 52.85 kg) respectively. The influence of pranic energy probably has improved cellular growth and division and increased ATPase activity and has a positive effect on growth and yield (Jois et al., 2017). In another similar pranic agriculture study in Papaya seedlings, pranic energy treated seeds showed significant ($p < .05$) variation for mean germination days (11.3), shoot length (7.3 cm), number of leaves (7.6), leaf length (3.4cm), leaf diameter (2.9 cm) and seedling vigour index I (2350) and seedling vigour index II (1564) as compared to untreated seeds (14.7, 5.6 cm, 5.1, 2.1 cm, 1.7 cm, 1626 and 624) respectively (Prasad and Jois, 2020).

Pranic energy supplied to the seeds during cell division, growth and differentiation probably resulted in enhanced growth of pranic treated papaya.The flowering time and time of transition from vegetative to reproductive development is affected by environmental conditions as well as hormonal action (Muller and Leyser 2011; Davies et al., 2010. The externally applied pranic energy might have brought changes in the hormonal signalling pathway at the cellular receptor level and lead to the variation in the flowering duration and flower yield (Denay et al., 2017; Campos et al., 2017). In a similar study different types of hormones viz. auxin (NAA at 100,200 and 300 ppm) and cytokinin (BA at 25, 50 and 75 ppm) and (Kinetin at 50,100 and 150 ppm) were applied at different concentrations. Among different treatments NAA @ 300 ppm recorded maximum number of flowers per plant (57.60), the average weight of flowers (12.93g), the average diameter of flowers (9.20 cm) and yield of flowers per plant (744.7 g), flowers per plot (7.36 kg) and flowers per hectare (170.37 q) (Bairwa and Mishra., 2017).

The number of flowers produced per plant is directly related with the number of branches per plant. Higher plant spread and a number of branches in pranic treatment resulted in more photosynthesis due to higher source capacity with enhanced food accumulation. Further higher source capacity might have resulted in better transportation to sink and subsequently a bigger and higher number of flowers per plant. Similar findings have been reported in African marigold with thirteen different nutrient treatments with two biofertilizers (Azotobacter and PSB) combinations. Treatment, T11(PSB+ *Azaobacter*+Full K+FYM+half N and P) recorded maximum plant spread (3420.1 and 3502.6 cm), number of branches per plant (13.59 and 15.69), number of days for bud initiation(48.20 and 45.12 days), first flower opening (9.30 and 11.65 days, marked increase in flowering span (41.39 and 45.79), flower diameter(7.10cm 8.54cm), number of flowers per plant (28.93 and 29.44 cm) compared to other treatments at year the 2004 and 2005 respectively (Bairwa and Mishra., 2017).

Combination of biofertilizers and organic manure has reduced to dosage of organic fertilizer by 50% was advantageous (Kumar et al., 2019). Similar improvements in Marigold flower diameter (7.39 cm), flower weight (7.43 g), number of flowers per plant (52.37), flower yield per plant (388.33g) and yield per hectare (14.38t) were recorded with the application of integrated nutrient combination (70%RDF+Vermicompost+Azotobacter+ Azospirillum + PSB) followed by other nutrient combinations and control (Mittal, et al., 2010). The results were attributed to the constant and optimal supply of nutrients throughout the growth period influenced better growth.

In a study of Okra, seeds were treated with a magnetic field of 99 mT for 3 min and 99 mT for 11 min exposure before sowing. Treatment of 99 mT for 11 min showed significant variation in germination percentage (71), number of flowers per plant (21.75), plant height at maturity (102), number of pod per plant (16), pod mass per plant(692), and number of seeds per plant (133) as compared to control (53, 7.25, 73, 10, 350 and 59) respectively. The effect of treatment is not only dependent on the magnetic field but also the duration of exposure (Naz et al., 2012; Kumar et al., 2019).

CONCLUSION

Pranic energy application on marigold has resulted in higher plant spread and a higher number of flowers per plant ultimately leading to higher yield per plant. Pranic agriculture can be adopted easily by the farmer himself in his field by learning the pranic healing

technique without any additional input cost. Further studies are in progress to understand the mechanism of pranic energy influence on the plant at the cellular and whole plant level. PA is an easy technique to learn by farmers and can apply to their crops to fetch higher yield and improve their economic status. PA can become one of the supportive farming system in coordination with conventional farming methods to achieve global agriculture sustainability.

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