



Growth and Flower Production as Influenced by Pinching in African marigold: A Review

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Abstract

Flowers are symbolize the most sensitive, delicate and loving feelings eloquently what our words fail to express. It also symbolizes the quintessence of human spirit; it adorns the surface of earth with a splendid array of colours – soft, muted and dazzling, filling the whole atmosphere with its delicate fragrance. Flowers are grown and admired by human beings wherever he lives. A study was carried out to review on effect of pinching in marigold. The experiments consist of treatments like no pinching, single pinching after 15,22,28,30 and 45 days after transplanting. The results showed that maximum plant spread, number of primary branches diameter of stem, diameter of flower, weight of single flower, flower yield per plant and per ha were found superior in pinching treatment. However, pinching treatment delay the flowering so it best for avoid the glut in the market. From the study, plant pinched between 30 days after transplanting were found best for better growth, flowering and yield of marigold.

Introduction

Marigold (*Tagetes erecta* L.) which occupies a prominent place in ornamental horticulture is one of the commercially exploited flower crops belonging to the family Asteraceae. Marigold is broadly divided into two groups, viz., African marigold (*Tagetes erecta* Linn) and French marigold (*Tagetes patula* Linn). The former generally grows tall and is known as tall marigold and latter is short called as dwarf marigold. African marigold is hardy annual about 80 - 100 cm tall, erect and produces branches. Leaves are pinnately divided and leaflets are lanceolate and serrated. The flowers are single to fully double and large size with globular heads. The floret is either two talpped or quilled. The flower colour observed in African marigold is either varies from lemon yellow or yellow or orange. It has gained popularities among gardeners on account of its easy culture, wide adaptability to varying soil and climatic conditions, profuse flowering habit, short duration to produce marketable flowers, wide spectrum of attractive colours, shape, size and good keeping quality. It is used in religious occasions for making garlands and wreaths.

Other than religious and social used, marigold especially is used for beautification and also used in landscape plans due to its variable height and colour of flowers. It is highly suitable as a bedding plant, as herbaceous border and is also ideal for newly planted shrubberies to provide colour and fill the spaces.

Apart from its significance in ornamental horticulture, it has been valued for other purposes too. The aromatic oil extracted from *Tagetes minuta* which is being traded as "Tagetes oil". It is used in preparation of high grade perfumes and also as an insect fly repellent. It has also got larvicidal properties. It is also being grown as trap crop in agriculture against some of lepidopterans, coleopterans and nematodes. Recently dried flower petals of marigold are used as poultry feed in order to improve the colour of egg yolk as well as broiler's skin.

The major marigold growing states are Karnataka, Maharashtra, Andhra Pradesh and West Bengal. In Maharashtra, marigold is grown over an estimated area of about 2800

ha with a production of 31500 MT flower and productivity is 11.25 MT ha⁻¹ (Anonymous. 2006).

A large number of factors are known to influence the yield and quality of marigold flowers viz., region, season, nutrition, irrigation and improved agro-techniques. In annual flower crops, flower yield is mainly dependent on number of flower bearing branches which can be manipulated by arresting the vertical growth of plants and encouraging side shoots by means of apical bud pinching (Bhati and Chitkara. 1987; Khandelwal. *et al.*, 2003; Tomar. *et al.*, 2004). Such side shoots would provide more scope to bear a more number of flowers and turn contributing for higher flower yield and also the uniform and regular availability of flower in the market. The major horticultural operation adopted to regulate the flower in definite interval is pinching. The pinching operation involves the removal of terminal growing portion of stem. Pinching can helpful to delay the flowering but increase the of flower. The objective of this operation is to encourage number of branching, produces the a bushy growth, production of more no of flowers per plant thereby increased the flower and seed yield per plant and per hectare

Effect of Pinching on Growth

Pinching might be due to the fact that by removal of apical portion move energy might have been to promote the number of side branches. Number of side branches directly positive correlated the yield of flowers in African marigold. Pinching at 20 days after transplanting resulted into maximum reduction in plant height (62.50 cm) and produced less number of branches per plant (10.80) compared to pinching at 40 days after transplanting (80.80 cm and 16.70 / plant, respectively) in marigold (Arora and Khanna. 1986). Pinching at 30 days after transplanting reduced plant height significantly in marigold cultivars African Giant Orange, African Giant Yellow and French Dwarf Red during rainy season (Bhati and Chitkara. 1987; Srivastava. *et al.*, 2002) observed that pinching at 20 days of transplanting resulted significantly

reduction in plant height (49.39 cm) but produced more number of secondary branches (35.29) compared to no pinching (63.46 cm, and 24.91 respectively) in African marigold cv. Pusa Basanti Gaiinda. Among the pinching treatments (pinching at 20 or 30 days after planting), pinching at 20 days after planting resulted more reduction in plant height (72.82 cm), and produced more number of branches (58.07) and stem diameter as compared to control.(10990cm and 38.62) African marigold (Khandelwal. *et al.*, 2003; Sehrawat. *et al.*, 2003) revealed that, pinching treatments had significantly reduced plant height (64.52 cm), especially when plants were pinched at 30 DAT as compared to rest of pinching treatments *i.e.* at 40 or 50 DAT in *Tagetes erecta* cv. African Giant Double Orange. (Chauhan. *et al.*, 2005) recorded reduction in plant height (17.60 cm) and more number of branches (11.22) per plant when the plants pinched at 30 days after transplanting compared to no pinching (27.66 cm and 9.64, respectively) in marigold cv. Pusa Narangi Gaiinda. (Manoj Kumar. 2006) carried out experiment on different pinching treatments at 7, 14, 21, 28 and 35 DAT in marigold at Hissar, Haryana and found that, reduction in plant height was recorded in all pinching treatments. However, more reduction in plant height and more no of branches was noticed when plants pinched at 28 DAT as compared to the other pinching treatments. Pinching at 40 DAT in African marigold recorded significantly more reduction in plant height, produced maximum number of branches, and no of leaves per plant, however, number of secondary branches were maximum in 20 DAT in African marigold cv. Pusa Narangi Gaiinda. (Sharma. *et al.*, 2006)

(Sunitha. *et al.*, 2007) revealed that, pinching at 45 DAT had recorded significantly less plant height (87.3) compared to un pinched plant while the number of primary branches per plant (12.0) maximum was in plant pinched once at 45 DAT as compared to no pinching in African marigold cv. Orange Double. (Rajbeer. *et al.*, 2009) reported that,

plant pinched at 40 DAT had produced more number secondary branches plant⁻¹ compared to control (no pinching) in African marigold cv. Pusa Narangi Gaiinda. (Maharnor. *et al.*, 2011) revealed that, double pinching at 30 DAT and 45 days DAT had resulted significantly minimum plant height whereas more number of primary branches, spread of plant and stem diameter was maximum with at 30 days pinching treatment compared to control (No pinching) in African marigold cv. Double Orange (Rathor. *et al.*, 2011) revealed that 1 pinching treatments significantly reduced plant height (64.40 cm), increased number of branches (37.67) compared to no pinching in marigold. (Pushkar and Singh. 2012) reported that, unpinched plant had recorded maximum plant height compared to pinching at 20 DAT and 30 DAT in African marigold cv. Pusa Narangi Gaiinda. (Sharma. *et al.*, 2012) stated that, minimum plant height was recorded in pinching treatment 40 DAT compared to other pinching treatments (pinching at 20 DAT and 30 DAT) and no pinching in African marigold. (Kumar. *et al.*, 2012) carried out the experiment in African marigold with three level of pinching (30, 40, 50 DAT) during rainy season and noticed that late pinching at 50 DAT had recorded minimum plant height (68.71 cm) . however spread of plant and number of primary branches per plant was maximum at 40 DAT compared to pinching at 30 and 40 DAT in African marigold cv. Pusa Narangi Gaiinda. (Rajyalakshmi and Rajashekhar. 2014) noted that maximum plant height (65.38 cm) as recorded in no pinching (61.02 cm) as compared to pinching in African marigold cv. Pusa Narangi Gaiinda.

More reduction in plant height, maximum number of primary branches, diameter of stem and plant spread recorded in pinching at 15 DAT as compared to no pinching (Badge. *et*

al., 2014; Sasikumar. *et al.*, 2015) carried out research on effect of pinching on growth and flowering in African marigold cv. Pusa Narangi Gaiinda and found that maximum plant height (67.0cm) was recorded in no pinching as compared to pinching (52.33cm) while spread of plant (34.0 cm²) and number of primary branches per plant (9.33) maximum in pinching as compared to no pinching (29.0 cm² and 5.33, respectively). (Meena. *et al.*, 2015) reported that African marigold with no pinching have maximum plant height as compared to pinching at 30 and 60 DAT but the number of branches per plant maximum in pinching at 60 DAT (21.91) as compared to no pinching (11.92) and pinching at 30 DAT (18.53). Stem diameters of plant were minimum in case of pinching at 60 DAT (1.35 cm) and no pinching (1.35 cm) and maximum in pinching at 30 DAT (1.36 cm)). (Mohanty. *et al.*, 2015) observed that shoot pinching at 30 days after planting improved plant spread and number of leaves as compared to no pinching. (Parhi. *et al.*, 2016) investigated that maximum plant height was found with no pinching (50.89cm) as compared to single pinching (47.52 cm) whereas leaf area (23.31cm²) and stem diameter (1.30 cm) was highest in pinched one as compared to no pinching (22.61cm² and 1.24cm, respectively) in African marigold cv. Sirakole. (Chauhan. *Et al.*, 2016) revealed that pinching was significantly increased the plant spread (52.14cm), number of leaves per plant(363.24), leaves area per plant (90.45cm²) as compared to no pinching (47.17 cm, 327.17, 82.85 cm²,respectively). (Prakash. *et al.*, 2016) recorded maximum plant height in no pinching (55.24 cm and 115.80 cm, respectively) as compared to pinched one (38.28 cm and 107.90 cm, respectively) whereas number of primary branches per plant (14.08 and 16.40, respectively) and number of secondary branches per plant

(62.20 and 59.48, respectively) were maximum in pinching treatment as compared to lowest in no pinching. Study was conducted with two levels of pinching (no pinching & pinching at 28 DAT) and three levels of spacing (40 x 40 cm, 40 x 30 cm & 30 x 30 cm) in all possible combinations. Maximum number of branches/plant (12.11), plant spread (63.59 cm), fresh weight of plant (358.79 g) were significantly recorded in plants pinched at 28 DAT at 5% level of significance, whereas, maximum plant height (73.52 cm) was obtained in un-pinched plants of African marigold (Nain. *et al.*, 2017). An experiment consisted of three treatments T1 (Control) -no pinching, T2- Single pinching 20 days after transplanting and T3-double pinching 15 days after single pinching was carried out to study the effect of pinching on flower yield of African marigold cv. Pusa Narangi Gaiinda and the results showed that maximum plant spread (47.2 cm) and number of branches (13.7) were observed in the double pinching treatment. (Baskaran and Abirami. 2017) (Sarkar. *et al.*, 2018) reported that among the pinching treatments, pinching at 40 DAT recorded significantly maximum number of branches (40.55 branches/plant) and total leaf number (180.54) as compare to other treatments. (Palekar. *et al.*, 2018) revealed that, significantly maximum stem diameter, primary and secondary branches plant⁻¹ and flower yield plant⁻¹ were noted with the plants treated with double pinching + 125 kg N ha⁻¹. (Wani. *et al.*, 2018) reported pinching at visible bud stage, significantly improves plant spread (37.73 cm), leaf area (5883.25 cm²), Leaf Area Index (LAI) (21.15), chlorophyll content (60.63), number of primary (16.64) and secondary branches (23.19). An experiment was conducted on the effect of pinching on growth and flower production on marigold pinched at a different height (0, 1foot). Data revealed that marigold

plant pinched at 1 foot height recorded maximum plant height(34.43cm), number of branches (12.41) and stem diameter (0.76cm), days to 50% flowering (54.9), flower diameter (4.58), and a number of flowers (9.93) (Khan. *et al.*, 2018).

(Sendhilmathan. *et al.*, 2019) study the effect of pinching and foliar application of organics on vegetative, floral attributes and quality of African marigold (*Tagetes erecta* L.) var. Maxima yellow. The experiment comprised of 10 treatment combinations of which pinching was carried out at 15, 20 and 25 days after transplanting along with foliar application of organics viz., humic acid @ 1%, Panchagavya @ 3%, Vermiwash @ 1:5 dilution and Control (without pinching). Among the treatments, pinching at 15 days after transplanting along with foliar spray of humic acid @ 1% significantly increased the growth parameters viz., number of laterals(76.73), number of leaves(186.26), leaf area (55.30 cm²), plant spread (41.98 cm) and stem diameter (1.75 cm). Among pinching and non-pinching treatments, maximum plant height (89.7cm) was observed in non- pinching, maximum number of primary branches (17.1 cm) was recorded in pinching treatment in African marigold variety Quality Kolkata local (Shashi Subedi. *et al.*, 2020).

Effect of Pinching on Quality Parameters

The notable effects of pinching can be seen in the flower size and flower diameter, weight of single flower, longevity of intact flower on plants and vase life. (Srivastava. *et al.*, 2002) reported that the average maximum diameter of flower was obtained in no pinching (control) treatment and minimum under the plant pinched at 20 DAT in African marigold cv. Pusa Narangi Gaiinda. (Khandelwal. *et al.*, 2003) revealed that unpinched plant had produced significantly more diameter of flower (6.34 cm) as compared to the pinched plant while longevity of intact flower on plant was more (19.39 days) in early pinching

compared to late pinching and control in African marigold cv. Pusa Narangi Gaiinda. Unpinched plants recorded maximum diameter of flowers (8.12 cm) compared to plants pinched at 40 DAT (7.82 cm) in marigold (Naik. *et al.*, 2004). (Manoj Kumar. *et al.*, 2006) stated that plants pinched at 28 DAT had recorded maximum flower diameter, longer stalk length of flower compared to rest of pinching treatments performed at 7, 14, 21, and 35 DAT in African marigold cv. Double Orange. Fresh weight (7.64 g) and dry weight (5.16 g) of flower was maximum in no pinching as compare to pinch one (7.12 g and 4.31 g) in African marigold (Rathore. *et al.*, 2011). On the contrast, (Mahanor. *et al.*, 2011) quoted that, the maximum stalk length of flower was achieved in control (no pinching) treatment while maximum longevity of intact flowers was achieved in single pinching at 30 DAT treatment compared to different pinching treatments in African marigold cv. Double Orange. (Khobragade. *et al.*, 2012) resulted that flower diameter (5.72 cm) and fresh weight of flower (6.59g) was maximum in case of no pinching as compare to pinch one (5.58 cm and 6.02g). The maximum stalk length found in pinching at 28 DAT was 4.90 cm and minimum stalk length was 4.66 cm in the non-pinched plant in marigold. Stalk length is increased in flower when pinched at 20 DAT (Puskar and Singh. 2012). (Sharma. *et al.*, 2012) exhibited that pinching treatment had recorded non-significant differences regarding diameter of flower in African marigold under Himachal Pradesh conditions. (Badge. *et al.*, 2015) resulted that maximum diameter of flower and pedicel length recorded in no pinching in African marigold. Maximum Fresh weight of flower per plant (358.79 g), and stalk length were significantly recorded in plants pinched at 28 DAT at 5% level of significance, whereas, flower diameter (6.38 cm), fresh weight of flower (8.93 g) was obtained in un-pinched plants (Nain. 2017). An experiment was carried out to study the effect of pinching on flower yield of African marigold cv. Pusa Narangi Gaiinda and showed that size of flower (6.18 cm) and weight of single flower (7.08g), were observed in the double pinching

treatment (Baskaran and Abirami. 2017). (Palekar. *et al.*, 2018) revealed that, maximum weight of flower, number of petals flower⁻¹ and longevity of flower were recorded with no pinching + 125 kg N ha in African marigold. Maximum stalk length, flower weight, dry flower weight, was obtained pinching at 28 DAT in African marigold (*Tagetes erecta* L.) cv. Local Selection (Kundu. *et al.*, 2019). The maximum the diameter of flower (4.29 cm) and the fresh weight per flower (4.32 g) were obtained in non- pinching treatment in African marigold cv. Quality Kolkata Local (Pandey. *et al.*, 2021).

Effect of Pinching on Flower Yield

Pinching increases the flower production. The number of flowers per plant is an important parameter to determine the production and yield of flowers. Singh and Arora (1980) found that flower yield plant⁻¹ was maximum when plants pinched at 40 DAT in marigold (*Tagetes erecta*) cv. African Giant Double Orange. (Srivastava. *et al.* 2002) recorded maximum number of flowers per plant (58.18) and flower yield (30.99 tonnes/ha) due to pinching at 40 days after transplanting compared to no pinching (42.80 and 22.40 tonnes/ha, respectively) in African marigold cv. Pusa Narangi Gaiinda. (Khandelwal. *et al.*, 2003) conducted a field experiment on effect of pinching on African marigold revealed that plants pinched 20 days after planting resulted in reduction of plant height (72.82 cm) and produced more number of branches (58.03) and flowers per plant (63.15) and highest flower yield (167.80 q/ha) as compared to no pinching. (Sehrawat. *et al.*, 2003) quoted that significantly the highest number of flower plant⁻¹ and highest flower yield plant⁻¹ was obtained with pinching the plant at 30 DAT in *Tagetes erecta* cv. African Double Orange. (Tomar. *et al.*, 2004) revealed that maximum number of flowers per plant (48.34) was obtained due to double pinching, followed by single pinching (32.86) as compared to control (17.63) in African

marigold. (Naik. *et al.*, 2004) observed that pinching at 40 days after transplanting recorded maximum flower yield (16.44 t/ha) as compared to unpinched plants in marigold. (Chauhan. *et al.*, 2005) reported that pinching at 30 days after transplanting recorded more number of flowers per plant (19.76) and flower yield (1700.78 g/m²) as compared to control (17.60 and 1120.53 g/m²) in African marigold cv. Pusa Narangi Gaiinda. Effect of pinching (no pinching, pinching at 20, 30 and 40 days after transplanting) on flowering of African marigold cv. Pusa Basanti Gaiinda, resulted that pinching at 40 days after transplanting delay in flowering, increased flowers per plant and improved flower quality as compared to no pinching and pinching at 20 and 30 DAT (Shrivastava. *et al.*, 2005). (Sharma. *et al.*, 2006) revealed that the maximum number of flowers plant⁻¹ (19.51), flowers yield plant⁻¹ (157.60 g) and hectare⁻¹ (131.48 q ha⁻¹) was obtained when plants pinched at 40 DAT compared to early pinching treatment at 20 DAT in African marigold cv. Pusa Narangi Gaiinda. (Manoj Kumar. 2006) noted that plant pinched at 28 DAT had obtained maximum number of flower plant⁻¹, highest flower and seed yield plant⁻¹ compared to rest of pinching treatments (7, 14, 21, and 35 DAT) in African marigold cv. Double Orange.

(Bhat and Shepherd. 2007) reported that double pinching significantly increased number of flowers per plant (63.81) and size of flower (5.05cm) as compared to single pinching in African marigold cv. Pusa Narangi Gaiinda. (Sunitha. *et al.*, 2007) reported that pinching of marigold cv. Orange Double significantly increased the number of flowers (61.9) as compared to no pinching (50.6). (Rajbeer. *et al.*, 2009) carried out a field experiment on marigold cv. Pusa Basanti Gaiinda with two levels of pinching i.e. one at

30 days and another at 40 days after transplanting, resulted that maximum number of flowers per plant (18.64) was obtained when pinching was done at 40 days after transplanting. Pinching increased the number of flowers per plant (82.14) and flower yield (96.78 q/ha) as compare to no pinching (68.78 and 86.35 q/ha)

(Rathore. *et al.*, 2011). (Maharnor. *et al.*, 2011) stated that, plant pinched at 30 DAT had produced maximum number of flower plant⁻¹ flower yield plant⁻¹ and hectare⁻¹ compared to control treatment (no pinching) in African marigold cv. Double Orange. (Khobragade. *et al.*, 2012) resulted that number of flowers per plant (55.52) and flower yield per plant (334.70 g) was maximum in pinched plant as compare to unpinched (39.47 and 266.91 g, respectively). (Pushkar and Singh. 2012) observed that, maximum number of flowers per plant were recorded with pinching 20 days after transplanting. The highest flower yield (203.00 q/ha) was obtained with pinching of terminal shoots at 30 days after transplanting in African marigold as compared to no pinching (Sharma. *et al.*, 2012). (Vijay Kumar. *et al.*, 2012) noticed that late pinching at 50 DAT had recorded minimum yield of flower plant⁻¹ and ha⁻¹ compared to pinching at 30 and 40 DAT in African marigold cv. Pusa Narangi. (Badge. *et al.*, 2014) revealed that maximum number of flowers per plant (31.10 and 34.10, respectively) with pinching at 15 DAT as compared to no pinching (24.35 and 25.01, respectively). (Meena. *et al.*, 2015) found that maximum number of flowers per plant (34.91) was recorded in double pinching at 30 and 60 days after transplanting followed by single pinching (31.97) and no pinching (28.90). (Mohanty. *et al.*, 2015) found that that shoot pinching at 30 days after planting was effective in bringing significant improvement

weight of flowers per plot (3745.95 g), yield of flowers per hectare (13873.0 kg) number (173.01) and weight (0.25g) of seeds per head as well as seed yield (309.77 kg) per hectare as compared to no pinching. (Parhi. *et al.*, 2016) carried research on African marigold cv. Sirakole with three levels of pinching (i.e. no pinching, single pinching at 30 days after transplanting and double pinching at 30 and 45 days after transplanting) and found that maximum number of flowers produced in plant with single pinching (39.34) followed by double pinching (38.16) and no pinching (34.50). (Prakash. *et al.*, 2016) reported that effect of pinching on two varieties (Pusa Narangi Gaiinda and Pusa Basanti Gaiinda) of African marigold resulted number of flowers per plant and flower yield per plant was maximum in pinched once. (Nain. *et al.*, 2017) revealed that maximum number of flowers/plant (54.54), flower yield/plant (403.68 g) and flower yield/hectare (33.33 t) were significantly recorded in plants pinched at 28 DAT at 5% level of significance in African marigold. An experiment was carried out to study the effect of pinching on flower yield of African marigold cv. Pusa Narangi Gaiinda the experiment consisted of three treatments T1 (Control) -no pinching, T2-Single pinching 20 days after transplanting and T3-double pinching 15 days after single pinching. The results showed that number of flowers per plant (56.6), size of flower (6.18 cm), flower yield per plant (347.8 g) and seed yield per plant (20.23g) were observed in the double pinching treatment. The flower yield was maximum in double pinching with three times more yield than the control (Baskaran and Abirami. 2017). Pinching significantly increase the flower yield per plant when done in 15 DAT and gives net monetary returns with higher B/C ratio in African marigold (Badge and Panchbhai. 2018). (Sarkar. *et al.*, 2018) observed that among the pinching

treatments, pinching at 40 DAT recorded significantly maximum number of flowers (62.78) flower per plant and yield per hectare (10.20 t) as compare to other treatments. Singh *et al.* (2018) reported that pinching at 30 DAT recorded significantly maximum flowers yield (224.10 q/ha) as compare to other treatments in African marigold. Field experiment was conducted to study the optimum time of pinching for better flower production in African marigold cv. Local selection. There were six levels of pinching i.e. No pinching, 7 DAT, 14 DAT, 21 DAT, 28 DAT and 35 DAT. The maximum number of flowers per plant, flower yield per plant and flower yield per hectare was obtained at pinching 28 DAT (Kundu. *et al.*, 2019). (Sendhlnathan. *et al.*, 2019) study the effect of pinching and foliar application of organics on vegetative, floral attributes and quality of African marigold var. Maxima yellow and found that among the treatments, pinching at 15 days after transplanting along with foliar spray of humic acid @ 1% significantly increased number of flowers per plant (33.16). (Pandey. *et al.*, 2021) found that the highest number of flowers (60.66), yield per plant (237.49 g) and yield per hectare (9.89 t/ha) were obtained with pinching treatment in African marigold.

Conclusion

Marigold is an economic flowering plant that contributes to a large sector of the flower economy in India. Pinching not only helps to increase flower production but also helps in maintain regular supply of flower in the market to avoid the glut. Pinching might be due to the fact that by removal of apical portion move energy might have been to promote the number of side branches. Number of side branches directly positive correlated the yield of flowers in African marigold. From above study plants pinched between 15 to 40 DAT were found best for better growth, flowering and yield of marigold. Form the above discussion we can conclude that pinching significantly

increase the flower production along with branching per plant, flower per plant and flower diameter as well. The use of pinching along with the appropriate spacing, planting season, use of PGR and variety is beneficial for the flower growing farmers helping them to increase their production and getting maximum monetary returns.

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