The Pharma Innovation Journal 2023; 12(2): 1828-1833

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 1828-1833

www.thepharmajournal.com
Received: 03-12-2022
Accepted: 04-01-2023

Pankaj Sharma
Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh, India

BP Bisen
Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh, India

Akhilesh Tiwari
Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh, India

HK Rai
Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Pankaj Sharma
Department of Horticulture, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh, India

Effect of super absorbent polymer and mulching on morpho-phenological and yield characteristics of cucumber (*Cucumis sativus* L.)

Pankaj Sharma, BP Bisen, Akhilesh Tiwari and HK Rai

Abstract
The experiment was conducted at Naturally Ventilated Polyhouse (VRC) at Maharajpur, Department of Horticulture, JNKVV, Jabalpur during the years 2020–21. The experiment was laid out in a completely randomized design with three replications comprising of 18 treatment combinations. Data analysis statistically indicated that among the treatments, the highest vine length (202.33 cm), earliest 33.03 days to flower initiation, earliest 36.06 days to attain 50% flowering, and more number of 75.33 flowers per plant, Early days to first picking (38.74 days) and last picking (88.40 DAS) of fruits and fresh fruit weight (190.18 g) were noted when the crop was grown under the treatment combination Mulch+ 10 g Hydrogel + 25% moisture depletion (T_{18}). Higher number of 35.67 fruits per vine was registered under T_{17}-Mulch+ 10 g Hydrogel + 50% Moisture depletion. Cucumber plants possessing fruits with maximum length (19.45 cm) and diameter (5.55 cm) along with higher fruit yield 5.44 kg per vine and fruit yield 725.20 q/ha were observed when the fruits were harvested from treatment combination consisting of Mulch+ 10 g Hydrogel + 25% moisture depletion (T_{18}). Thus from the findings, it was confined that when cucumber is grown under treatment with mulch, 10 g Hydrogel + 25% moisture depletion showed profound morpho-phenological attributes and yielded better.

Keywords: Cucumber, Super absorbent polymer, hydrogel, irrigation scheduling, mulch and Polyhouse

Introduction
Cucumber (*Cucumis sativus* L.) is one of the most significant fruit vegetable crops, both nutritionally and economically. It is cultivated in the tropical as well as temperate regions of the world. It belongs to the Gourd family Cucurbitacea. Being Thermophilic in nature, the crop requires a steady warm temperature to attain optimum marketable fruit yield. Cucumber is extensively used in salad, dishes, sandwiches, and pizza, and thus demanded by consumers round the year. It is pre-dominantly produced and profoundly grown during Zaid and Kharif season in India. It is a high value and low volume crop which is commercially exploited in greenhouses as an off-season crop thus producing higher income for the growers. In India, cucumber is cultivated in the states of Haryana, Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh, Punjab, Assam state. (Anonymous, 2018) [2]. In India, total cucumber production is 1259.94 thousand MT generated from an area of 82.04 thousand ha. In Madhya Pradesh, the production of cucumber is 154.52 thousand MT attained from an area of 9.46 thousand Ha (Anonymous, 2018) [2].

The immature fruit of cucumber is used as salad and for making pickles, rayata and brined on commercial scale. The fruit comprise of 93-95 % moisture content and encompasses sodium, magnesium, vitamins, potassium, sulphur, silcon, fluorides *etc*. in a considerable amount. The mineral that makes it alkaline accounts for 64.05% of the total, while the acid-creating substance accounts for the remaining 35.95%. These are beneficial in preserving the alkalinity of the human blood.

Irrigation water stress is one of the most significant limiting variables affecting crop, flower, fruit, and productivity growth. Plastic mulches are completely impermeable to water and improve plant growth, development, and agricultural production efficiency. As a consequence, it inhibits direct evaporation of moisture from the soil, minimizing water losses and soil erosion over the surface. In this approach, it assists in water conservation. Evaporation suppression has a secondary impact. As a result, it enables for even more soil moisture retention and tends to moderate temperature differences, improves physical, chemical, and biological properties of soil, adds nutrients to the soil, and ultimately increases crop

development and production (Kumar *et al*., 1990) [18]. Mulch may also successfully reduce water vapour loss, soil erosion, weed issues, and nutrient loss.

Hydrogel is a natural product used to increase crop output per unit of available water and nutrients, particularly in moisture-stressed agriculture. Synthetic polymers can be found in the form of crystals or little beads. Some of the brand names include Pusa Hydrogel, very absorbent polymers, and root watering crystals. Drought crystals and hydrogels are both referred to as hydrogels. Hydrogel is a water-retaining, biodegradable, cross-linked hydrophilic polymer that can absorb and retain 400 times its weight in water. A minimum of 95% of the stored water must be made available for agricultural irrigation (Johnson and Veltkamp, 1985) [13].

Irrigation water stress is one of the most significant limiting variables affecting crop, fruit, and productivity growth. The hydrogel is a soil conditioner that can absorb and retain huge amounts of plant-available water. When the surrounding soil in the plant's root zone begins to dry out, the hydrogel distributes water and nutrients to the plant. Plastic mulches are fully impermeable to water and improve plant growth, development, and agricultural production efficiency. As a result, it inhibits direct evaporation of moisture from the soil, limiting water losses and soil erosion over the surface. In this way, it contributes to water conservation. The inhibition of evaporation has an additional consequence. Hence, it improves physical, chemical, and biological qualities of soil, as it supplies nutrients to the soil, and thus promotes crop development and production (Kumar *et al.*, 1990) [18]. Saving irrigation water and therefore enhancing crop water use efficiency (WUE) is especially crucial in water-stressed areas (Gencoglan *et al.*, 2006) [9]. The current examination was carried out with the aforementioned facts in mind.

Material and Methods

The experiment was carried out in the Naturally Ventilated Polyhouse at Vegetable Research Centre(VRC), Maharajpur, Department of Horticulture, JNKVV, Jabalpur. It is located in Madhya Pradesh's "Kymore plateau" agro-climatic area at 23.10°N latitude and 79.58°E longitude, at an elevation of 412.08 metres above mean sea level. The soil in the trial field was laterite soil, which is assumed to have evolved in hot, humid subtropical locations and has high drainage, a homogenous texture, and a rock type rich in iron and aluminum. The trial used a Complete Randomized Block Design and three replications, each with 18 treatments. Moisture depletion was 100%, 50%, and 25% when combined with zero, 5g, and 10g SAP either with or without mulch. In each treatment, 14-day-old seedlings were transplanted with a spacing of 60 cm among plants and 100 cm between rows in a paired row arrangement. The vegetative and yield metrics were recorded from a randomly selected five tagged plants of each treatment and averaged for preliminary investigation. To assess the major impacts of mulching, hydrogel, and irrigation schedule on cucumber morpho-phenological and yield characteristics, all data were subjected to analysis of variance. The collected data was tabulated and analyzed using analysis of variance (ANOVA) in accordance with a fisher model (1935).

Result and Discussion

Vine length (cm) (75 DAS)

The data presented in Table 1 indicates that SAP, mulch and irrigation scheduling significantly promote the increase in vine length by 75 DAS. In general, a steady increase in vine length was seen as crop growth advanced. The maximum vine length (202.33 cm) was found with treatment T_{18} Mulch + 10 g hydrogel + 25% moisture depletion followed by 202.00 cm noted under treatment (T_{17}) *i.e.* Mulch + 10 g hydrogel + 50% moisture deletion (202.00 cm). The minimum increase in vine length 183.14 cm was noted with no mulch, no hydrogel, and 100% moisture depletion (T_1). The increasing level of SAP and mulch significantly increased the vine length. Due to increased moisture retention, plant height was more and indirectly through the hydrophilic polymers supply of nutrients, where it could have helped in increasing the activity of cell division, expansion and elongation, ultimately leading to increased plant height. Anupama *et al*. (2007) [4] found similar results in chrysanthemum. The increase in the vine length may be due to supply of soil moisture around the root zone, which provided suitable micro environment for uptake and translocation of the nutrients which finally resulted in plant growth and development. (Saini *et al*., 2018) [28]. An increase in vine length might be attributed to water availability and indirectly nutrients provided by hydrogel, which have been reported to increase the activity of cell division, cell expansion and cell elongation, ultimately leading to an increased plant. Similar results have been reported by Sivalapan (2001) [30] The increase in growth parameters with mulch may be due to minimized evaporation loss and extended retention of moisture. Similar results have been reported by Parmar, *et al*., (2013) [25], Dean ban *et al*., (2004) [5], Ansary and Roy (2005) [3] in watermelon

Days to flower initiation

The findings in Table 1 showed that the days to flower initiation decreased significantly with SAP, mulch and irrigation scheduling. The treatment T18-Mulch + 10 g Hydrogel + 25% Moisture depletion resulted in the earliest days to flower initiation of 33.03 DAS followed by treatment T_{17}-Mulch+ 10 g Hydrogel + 50% Moisture depletion had the days to flower initiation(34.00 DAS). The highest days to flower 40.82 DAS was noted with control T_1-No Mulch+ No Hydrogel + 100% Moisture depletion. Due to mulch raised soil temperature around roots, enhanced water and nutrient uptake, and stimulated the flowering period Farias-Larios *et al*. (1994) [7] reported that plastic mulch use shorter cucumber flowering days.

Days to 50% flowering

The findings in Table 1 showed that the days to 50% flowering decreased significantly with SAP, mulch and irrigation scheduling. The treatment T18-Mulch + 10 g Hydrogel + 25% Moisture depletion resulted in the earliest days to 50% flowering of 36.06 DAS followed by treatment T17-Mulch+ 10 g Hydrogel + 50% Moisture depletion had the days to 50% flowering (37.33 DAS). The highest Days to 50% flowering 45.08 DAS was noted with control T1-No Mulch+ No Hydrogel + 100% Moisture depletion. This might be due to the fact that optimum availability of moisture and mulch application helped in enhancing vegetative growth and carbohydrate accumulation which induced early flowering, fruiting and harvesting, assisted by more availability of water. Sufficient water application is important for horticultural crops because water shortage in soil can cause flower and fruit drop (Kaya *et al.*, 2005) [16].

Number of flower per plant

The findings in Table 1 showed that the number of flower increased significantly with SAP, mulch and irrigation scheduling. The treatment T_{18}-Mulch+ 10 g Hydrogel + 25% Moisture depletion resulted in the highest number of flower of 75.33 followed by treatment T_{15} (Mulch+ 5 g Hydrogel + 25% Moisture depletion) had the next-highest number of flower 74.00. The lowest number of flower 52.00 was noted with treatment T_1- No Mulch+ No Hydrogel + 100% Moisture depletion. Water stress as a disturbing factor in plant physiology affects the flowering attributes of a plant. In the current study the number of flowers increased with the increase in the concentration of hydrogel. It was probably due to the availability of adequate soil moisture and assimilates from source to sink during flower formation Kumari *et al*. (2017) [19].

Number of fruit per vine

The findings in Table 1 showed that the number of fruit per vine increased significantly with SAP, mulch and irrigation scheduling. The treatment T_{17}-Mulch+ 10 g Hydrogel + 50% Moisture depletion resulted in the highest number fruit per vine of 35.67 followed by treatment T_{18} (Mulch+ 10 g Hydrogel + 25% Moisture depletion) had the next-highest number fruit per vine 35.47. The lowest number fruit per vine 24.87 was noted with treatment T_1- No Mulch+ No Hydrogel + 100% Moisture depletion. The correlation between the number of fruits and the soil moisture level made it clear that the soil moisture level and the quantity of fruits produced per plant were significantly associated with mulching thus simultaneously increasing the number of fruits per plant and decreasing the proportion of fruit abortion.

Numbers of days to first picking

The information shown in Table 1 indicates that the numbers of days to first picking was significantly increased by SAP, mulch and irrigation scheduling. It was noticeable that all of the treatments considerably varied from one another, and that the numbers of days to first picking decreased as the level of SAP, mulch and irrigation scheduling increased. Mulch+ 10 g Hydrogel + 25% moisture depletion (T_{18}) resulted in earliest numbers of days to first picking 38.74 DAS, followed by treatment T_{15} (Mulch+ 5 g Hydrogel + 25% moisture depletion) 39.40 DAS. The highest numbers of days to first picking 47.12 was noted with control (T_1) *i.e.* No Mulch + No Hydrogel + 100% moisture depletion. Results presented revealed that polythene mulch resulted in early flowering, fruiting and harvest, whereas 'no mulch treatment' took maximum number of days for flowering, fruiting and harvesting. Using the different types of mulching materials evoked significant influence of minimum days to first flowering and fruit yield was recorded by Khan *et al*., (2015) [17].

Table 1: Morpho-phenological and yield characteristics Influenced by SAP, Mulch and Irrigation Scheduling of Parthenocarpic Cucumber

Treatments	Vine length (cm) 75DAS	Days to flower initiation	Days to 50% flowering	Number of flower per plant	Number of fruit per vine	Numbers of days to first picking
T_1 (No Mulch+ No Hydrogel + 100% Moisture depletion)	183.14	40.82	45.08	52.00	24.87	47.12
T_2 (No Mulch+ No Hydrogel + 50% Moisture depletion)	190.16	38.30	42.46	60.27	26.40	45.64
T_3 (No Mulch+ No Hydrogel + 25% Moisture depletion)	191.29	37.40	41.45	68.00	28.13	45.40
T_4 (No Mulch+ 5 g Hydrogel +100% moisture depletion)	184.99	38.30	42.30	52.67	26.67	44.94
T_5 (No Mulch+ 5 g Hydrogel + 50% Moisture depletion)	190.16	37.37	41.34	62.93	28.47	43.37
T_6 (No Mulch+ 5 g Hydrogel + 25% Moisture depletion)	192.00	36.74	40.84	72.33	29.60	44.20
T_7(No Mulch+ 10 g Hydrogel +100% Moisture depletion)	185.80	36.37	40.54	55.67	28.33	44.10
T_8(No Mulch+ 10 g Hydrogel + 50% Moisture depletion)	192.49	36.15	40.18	65.60	30.80	43.37
T_9(No Mulch+ 10 g Hydrogel + 25% Moisture depletion)	194.95	35.81	39.81	72.33	32.73	43.00
T_{10}(Mulch+ No Hydrogel + 100% Moisture depletion)	195.85	36.92	39.95	55.00	28.00	45.90
T_{11}(Mulch+ No Hydrogel + 50% Moisture depletion)	196.00	36.40	39.45	59.27	29.27	43.60
T_{12}(Mulch+ No Hydrogel + 25% Moisture depletion)	197.00	35.74	38.78	69.33	30.00	43.40
T_{13}(Mulch+ 5 g Hydrogel + 100% Moisture depletion)	199.52	35.92	38.93	53.67	31.93	42.54
T_{14}(Mulch+ 5 g Hydrogel + 50% Moisture depletion)	199.67	35.26	38.32	64.33	33.33	42.30
T_{15}(Mulch+ 5 g Hydrogel + 25% Moisture depletion)	201.33	34.70	37.73	74.00	35.60	39.40
T_{16}(Mulch+ 10 g Hydrogel + 100% Moisture depletion)	199.18	34.25	37.36	56.67	35.33	41.40
T_{17}(Mulch+ 10 g Hydrogel + 50% Moisture depletion)	202.00	34.00	37.33	66.60	35.67	39.70
T_{18}(Mulch+ 10 g Hydrogel + 25% Moisture depletion)	202.33	33.03	36.06	75.33	35.47	38.74

C.D. at 5%	4.80	2.69	2.76	5.18	2.04	2.59
S Em ±	1.67	0.93	0.96	1.80	0.71	0.90

Number of days to last picking

The information shown in Table 2 indicates that the numbers of days to last picking was significantly increased by SAP, mulch and irrigation scheduling. It was noticeable that all of the treatments considerably varied from one another, and that the numbers of days to last picking increased as the level of SAP, mulch and irrigation scheduling increased. T_{18}- Mulch+ 10 g Hydrogel + 25% Moisture depletion resulted in heighst numbers of days to last picking 88.40 DAS, followed by treatment T_{15} (Mulch+ 5 g Hydrogel + 25% moisture depletion) 87.76 DAS. The lowest numbers of days to last picking 79.26 DAS was noted with control (T_1) *i.e.* No Mulch + No Hydrogel + 100% moisture depletion. Due to better nutrient and moisture aviability in the root zoone of plant.

Fruit length (cm)

According to the data on fruit length contained in Table 2, SAP, mulch and irrigation schedule enhanced fruit length. All of the treatments were found to be significantly different from an another, treatment T18 -Mulch+ 10 g Hydrogel + 25% Moisture depletion produced highest fruit length(19.45 cm) followed by treatment T15 -Mulch+ 5 g Hydrogel + 25% Moisture depletion 19.21. The lowest fruit length of 14.51 was obtained with control (T_1): no mulch + no hydrogel + 100% moisture depletion. An increase in fruit length related attributes could be because of sufficient availability of water and indirectly nutrients supplied by the SAP to the plants under water stress condition, which in turn lead to better translocation of water, nutrients and photosynthates and finally better fruit length and yield (El Hardy *et al.,* 2009). However plastic mulches produce better fruit length due to less competition among the plants appertaining to abiotic factors resulting in more number of branches, a higher leaf number, improving the leaf photosynthetic capacity of the plant and more number of flowers per vine. The results of the present study are in agreement with the findings of Siborlabane (2000) [29] in tomato and Locher *et al.* (2005) [20] in sweet pepper

Fruit diameter (cm)

According to the data on fruit diameter contained in Table 2, SAP, mulch and irrigation schedule enhanced the fruit diameter. The treatment shows significant difference among each other. Treatment combination comprising of Mulch+ 5 g Hydrogel + 25% Moisture depletion (T15) produced highest fruit diameter(5.55 cm) followed by treatment T18 -Mulch+ 10 g Hydrogel + 25% Moisture depletion wherein the fruits attained a diameter of 5.38 cm. The lowest fruit diameter (3.10 cm) was obtained with control (T_1): no mulch + no hydrogel + 100% moisture depletion. Fruit size is affected by mulching because it increases the availability of moisture and soil nutrients for fruit production. Under unmulched fruits, poor growth was resulted due to moisture stress conditions produced during fruit production. Fruit size is positively correlated with the increase in fruit volume. This can be attributed to higher cell division and cell elongation which results in larger fruits (Pande *et al.,* 2005) [24].

Fresh Fruit weight (g)

The findings in Table 2 showed that the fresh fruit weight increased significantly with SAP, mulch and irrigation scheduling. The treatment T18-Mulch+ 10 g Hydrogel + 25% Moisture depletion resulted in the highest fresh fruit weight 190.18 (g) followed by treatment T_{15} (Mulch+ 5 g Hydrogel + 25% Moisture depletion) had the next-highest fresh fruit weight 190.18(g). The lowest fresh fruit weight 160.52 (g) was noted with treatment T_1- No Mulch+ No Hydrogel + 100% Moisture depletion. Due to higher vegetative growth indicates for higher sink sizes and more effective sink formation, increased transfer of carbohydrates from vegetative to reproductive plant parts, and finally higher fruit weight. This finding is similar to that of Pattanaaik *et al.* (2015)[a] [26], Pattanaaik *et al.* (2015)[b] [27] and Kassim *et al.* (2017) [15].

Fruit yield (Kg/Vine)

According to the data on fruit yield per vine contained in Table 2, SAP, mulch and irrigation schedule enhanced fruit yield per vine. All of the treatments were found to be significantly different from one another, treatment T18 - Mulch+ 10 g Hydrogel + 25% Moisture depletion produced highest fruit yield(5.44 kg/vine) followed by treatment T15 - Mulch+ 5 g Hydrogel + 25% Moisture depletion 5.41 kg/vine. The lowest fruit yield of 2.87 kg/vine was obtained with control (T_1): no mulch + no hydrogel + 100% moisture depletion. An increase in yield related attributes could be because of sufficient availability of water and indirectly nutrients supplied by the SAP to the plants under water stress condition, which in turn lead to better translocation of water, nutrients and photosynthates and finally better plant stand and yield (El Hardy *et al.,* 2009). However plastic mulches produce more fruit due to less competition among the plant for abiotic factors resulting in more number of branches, a higher leaf number, improving the leaf photosynthetic capacity of the plant, and more number of flowers per vine. The results of the present study are in agreement with the findings of Siborlabane (2000) [29] in tomato and Locher *et al.* (2005) [20] in sweet paper. It can be affirmed that the application of hydrogel in mixture with substrate will decrease the use of fertilizers, will improve the physical properties of substrates, water availability and yield (Ortega and Soto Zarazúa, 2017; Gholamhoseini *et al*., 2018) [23, 10].

Fruit Yield (q/ha)

Fruit yield was lower under the water-stressed treatment than in the moisture-maintained plants (Table 2). Treatment T18 - Mulch+ 10 g Hydrogel + 25% moisture depletion produced the highest fruit yield (725.20 q/ha), followed by treatment T15 -Mulch+ 5 g Hydrogel + 25% Moisture Depletion *i.e.,* 721.33 q/ha. The lowest fruit yield 382.67 q/ha was obtained with treatment T_1-No mulch + No hydrogel + 100% moisture depletion. An increase in yield and yield related attributes could be because of sufficient availability of water. It may be due to super absorbing properties of the hydrogel which absorbs the water and releases it slowly to the growing plants as per the crop needs. The positive effect of superabsorbent polymers in increasing the yields was reported by Gunes *et al.* (2016) [11] and Kumari *et al*., (2017) [19] in maize crop.

The highest fruit length, fruit girth, average fruit weight, fruits per vine, fruit yield per vine and fruit yield per hectare were

recorded with optimum moisture content in the soil during the growth period. Similar findings were also reported by Ningaraju and Joseph (2014) [22] in pickling melon. Similarly, Losada and Rincon (1994) found that water stress strictly influenced fruit set and fruit number. Mao *et al*., (2003) [21] reported that fresh fruit yield was influenced moisture content in the soil. The various yield parameters viz. fruit length, girth, average fruit weight, number of fruits per vine, fruit yield per vine and yield were higher with black polythene mulch compared to no mulch treatment. This might have been influenced by favorable soil temperature, moisture conditions and pest-disease control under black polythene mulch. The present finding was in collaboration with Johnson *et al*., (2000) [14]. Similar results have been reported by Khan *et al*., (2015) [17] in sponge gourd, Aniekwe *et al*., (2015) [1] in cucumber, and Ibarra–Jimenez *et al*., (2008) [12] in cucumber.

Table 2: Morpho-phenological and yield characteristics Influenced by SAP, Mulch and Irrigation Scheduling of Parthenocarpic Cucumber

Treatments	Number of days to last picking	Fruit length (cm)	Fruit diameter (cm)	Fresh Fruit weight (g)	Fruit yield per vine (Kg)	Fruit yield (q/ha)
T_1 (No Mulch+ No Hydrogel + 100% Moisture depletion)	79.26	14.51	3.10	160.52	2.87	382.67
T_2 (No Mulch+ No Hydrogel + 50% Moisture depletion)	79.53	14.60	3.13	162.08	3.14	418.22
T_3 (No Mulch+ No Hydrogel + 25% Moisture depletion)	80.73	15.00	3.97	163.08	3.44	458.67
T_4 (No Mulch+ 5 g Hydrogel +100% moisture depletion)	80.00	14.80	3.43	162.26	3.19	425.33
T_5 (No Mulch+ 5 g Hydrogel + 50% Moisture depletion)	81.53	16.08	4.20	164.51	3.53	470.67
T_6 (No Mulch+ 5 g Hydrogel + 25% Moisture depletion)	82.06	16.32	4.30	164.78	3.71	495.11
T_7(No Mulch+ 10 g Hydrogel +100% Moisture depletion)	81.33	16.50	4.40	165.09	3.52	469.33
T_8(No Mulch+ 10 g Hydrogel + 50% Moisture depletion)	82.20	16.85	4.44	167.11	3.98	530.67
T_9(No Mulch+ 10 g Hydrogel + 25% Moisture depletion)	83.06	17.00	4.60	168.08	4.33	576.89
T_{10}(Mulch+ No Hydrogel + 100% Moisture depletion)	84.26	15.25	4.00	163.19	3.43	457.33
T_{11}(Mulch+ No Hydrogel + 50% Moisture depletion)	85.06	17.67	4.80	172.08	3.83	510.67
T_{12}(Mulch+ No Hydrogel + 25% Moisture depletion)	85.73	18.08	4.90	174.08	4.00	533.33
T_{13}(Mulch+ 5 g Hydrogel + 100% Moisture depletion)	85.00	18.75	5.07	187.11	4.66	621.33
T_{14}(Mulch+ 5 g Hydrogel + 50% Moisture depletion)	86.10	19.00	5.27	188.44	4.96	661.33
T_{15}(Mulch+ 5 g Hydrogel + 25% Moisture depletion)	87.76	19.21	5.55	190.18	5.41	721.33
T_{16}(Mulch+ 10 g Hydrogel + 100% Moisture depletion)	86.33	18.90	5.16	187.11	5.30	706.67
T_{17}(Mulch+ 10 g Hydrogel + 50% Moisture depletion)	87.20	18.67	5.30	188.44	5.40	720.00
T_{18}(Mulch+ 10 g Hydrogel + 25% Moisture depletion)	88.40	19.45	5.38	190.18	5.44	725.20
C.D. at 5%	1.77	1.01	0.30	4.52	0.78	103.66
S Em ±	0.62	0.35	0.11	1.57	0.27	35.99

Conclusion

From the above results, it can be concluded that the highest vine length, earliest days to flower initiation and 50% flowering and more number of flowers per plant, Early days to first picking and last picking of fruits were noted When the crop was grown under the treatment combination Mulch+ 10 g Hydrogel + 25% moisture depletion (T18). Cucumber plants possessing fruits with maximum length and diameter along with higher fruit yield kg per vine and Fruit yield q/ha were observed when the fruits were harvested from treatment combination consisting of Mulch+ 10 g Hydrogel + 25% moisture depletion (T18). Thus from the findings, it was confined that when cucumber is grown under treatment with mulch, 10 g Hydrogel + 25% moisture depletion showed profound morpho-phenological attributes and yielded better.

References

1. Aniekwe NL, Anike NT. Effects of different mulching materials and plant densities on the environment, growth and yield of cucumber. Journal of Agriculture and Veterinary Science. 2015;8:64-72.
2. Anonymous. Horticultural Statistics at a Glance. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare. Ministry of Agriculture & Farmers Welfare Government of India, 2018.
3. Ansary SH, Roy DC. Effect of irrigation and mulching on growth, yield and quality of watermelon (*Citrullus lanatus* Thunb.). Environment and Ecology. 2005;23(Spl-1):141-143
4. Anupama, Singh MC, Kumar R, Parmar BS. Performance

of a new superabsorbent polymer on seedling and post planting growth and water use pattern of chrysanthemum grown under controlled environment. Proc. Int. Conf. & Exhibition on Soilless Culture. Acta Horticulturae. 2007;742:43-49.
5. Dean B, Zanic K, Dumicic G, Culjak TG, Ban SG. The type of polythene mulch impacts vegetative growth, yield and aphid populations in watermelon production. J Food, Agri. and Envi 2004;7(3-4):543-550.
6. El-Hady OA, Abd El-Kader AA, Shafi AM. Physico-bio-chemical properties of sandy soil conditioned with acrylamide hydrogels after cucumber plantation. Australian Journal of Basic and Applied Sciences. 2009;3(4):3145-3151.
7. Farias-Larios J, Gumez S, Michel AS. Effect of plastic mulch on the growth and yield of cucumber in a tropical region. Biological Agriculture and Horticulture 1994;10:303-306
8. Fisher RA. The design of experiments. Oliver and Boyd. London 4th Edition. 1935;
9. Gencoglan C, Altunbey H, Gencoglan S. Response of green bean (*P. vulgaris* L.) to subsurface drip irrigation and partial rootzone-drying irrigation. Agricultural Water Management. 2006;84:274-280.
10. Gholamhoseini M, Habibzadeh F, Ataei R, Hemmati P, Ebrahimian E. Zeolite and hydrogel improve yield of greenhouse cucumber in soil-less medium under water limitation. Rhizosphere. 2018;6:7-10. [Links]
11. Gunes A, NurulKitir, Metin Turan, Erdal Elkoca, Ertan Yildirim, Nazmiye. Evaluation of effects of water saving superabsorbent polymer on corn (*Zea mays L.*)under drought stress. J. Sc. Food and Agric. 2016;91:813-819.
12. Ibarra Jimenez L, Zermeno Gonzalez A, Munguia Lopez J, Quezada Martin, MAR, Rosa Ibarra M de La. Photosynthesis, soil temperature and yield of cucumber as affected by colored plastic mulch. Acta Agriculturae Scandinavica Section B, Plant Soil Science, 2008;58(4):372-378.
13. Johnson MS, Veltkamp CJ. Structure and functioning of water-storing agricultural polyacrylamides. Journal of the Science of Food and Agriculture. 1985;36(2):789-793.
14. Johnson JM, Hough Goldstein JA, Vangessel MJ. Effects of Straw Mulch on Pest Insects, Predators, and Weeds in Watermelons and Potatoes. Environmental Entomology. 2000;33:1632-1643.
15. Kassim FS, El-Koly MF, Hosny SS. Evaluation of super absorbent polymer application on yield, and water use efficiency of grand naine banana plant. Middle East Journal of Agriculture Research. 2017;6(1):188-198.
16. Kaya CD, Kirnak HH. Influence of polyethylene mulch, irrigation regime, and potassium rates on field cucumber yield and related traits. Journal of Plant Nutrition. 2005;28:1739- 1753.
17. Khan S, Pal M, Kumar V. Influence of different mulches on growth and yield sponge gourd (*Luffa clyndrica* L.) Plant Archives. 2015;15(1):393-395.
18. Kumar D, Singh S, Kumar R. Importance of mulch in crop production. Indian Journal of Soil Conservation. 1990;18:20-26.
19. Kumari S, Solanki NS, Dashora LN, Upadhyay B. Effect of super absorbent polymer and plant geometry on growth and productivity of maize (*Zea mays* L.). Journal of Pharmacognosy and Phytochemistry. 2017;6(4):179-181.
20. Locher J, Ombodi A, Kassai T, Dimeny J. Effects of black plastic mulch and raised bed on soil temperature and yield of sweet pepper. International Journal of Horticultural Science. 2005;9(9):107-110.
21. Mao X, Liu M, Wang X, Liu C, Hou Z, Shi J. Effects of deficit irrigation on yield and water use of greenhouse grown cucumber in the North China Plain. Agricultral Water Management. 2003;61(3):219-228.
22. Ningaraju GK, Joseph PA. Effect of drip fertigation on growth and yield of oriental pickling melon (*Cucumis melo var.conomon* (L.) makino) under high density planting. International Journal of Scientific and Research Publications 2014;4(6):ISSN 2250-3153.
23. Ortega-Martínez LD, Martínez-Valenzuela C, Ocampo-Mendoza J, Sandoval-Castro E, Pérez Armendáriz B. Efficiency of substrates in soil and hydroponic system for greenhouse tomato production. Rev. Mex. Cienc. Agric. 2016;7(3):643-653. [Links]
24. Pande KK, Dimri DCand Prashant Kamboj. Effect of various mulches on growth, yield and quality of Apple. Indian J Hort., 2005; 62:145-47.
25. Parmar HN, Polara ND, Viradiya RR. Effect of mulching material on growth, yield and quality of watermelon (*Citrullus Lanatus* Thunb) Cv. Kiran. Universal Journal of Agricultural Research. 2013;1(2):30-37.
26. Pattanaaik SK[a], Singh B, Wangchu L, Debnath P, Hazarika BN, Pandey AK.s Effect of hydrogel on water and nutrient management of Citrus limon. International Journal of Agriculture Innovations and Research. 2015;3(5):1555-1558.
27. Pattanaaik SK[b], Wangchu L, Singh B, Hazarika BN, Singh SM, Pandey AK. Effect of hydrogel on water and nutrient management of Citrus reticulate. Research on Crops.2015; 16(1): 98-103
28. Saini AK, Patel AM, Saini LH, Patel KM, Patel GM. Influence of irrigation, fertility and hydrogel levels on yield and yield attributes of summer pearl millet (*Pennisetum glaucum* L.) in Gujrat. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):2914-2918
29. Siborlabane CH. Effect of mulching on yield and quality on fresh market in: Tomato Training Report. Training Report. Training course in vegetable production and Research. ARC- AVRDC. Nakhon Pathom, Thailand.2000; 1-5p.
30. Sivalapan S. Effect of polymer on growth and yield of soybean (*Glycine max* L.) grown in a coarse textured soil, In: Proceeding Irrigation, Regional Conf., Toowoomba, Queensland, Aust. 2001, 93-99.