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Effect of pollination time on fruit set and seed yield in hybrid seed production of cucumber (*Cucumis sativus*) cv. Pant Shankar Khira 1 under different growing conditions

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The present investigation was carried out at Centre for Protected Cultivation Technology at Indian Agricultural Research Institute, New Delhi during the summer and *kharif* seasons 2011 under naturally ventilated poly house, insect proof net house and open field conditions to study the effect of pollination time on fruit set and seed yield of cucumber (*Cucumis sativus* L.) cv. Pant Shankar Khira 1. Pollination was carried out at 7.00 AM, 9.00 AM and 11.00 AM in all three conditions in both the seasons. The experimental results showed that the pollination at 7.00 AM gave higher fruit set (3.43) and number of fruit developed to maturity (2.13) followed by 9.00 AM and 11.00 AM in all the three growing conditions during summer. Similar trend was observed in *kharif* season however, 7.00 AM gave higher fruit set (3.80) and number of fruit developed to maturity (2.20) followed by 9.00 AM and 11.00 AM as compared to summer. The reduced fruit set and fruit develop to maturity at 11.00 AM was due to increase in temperature and decrease in relative humidity which might have affected the pollen viability and stigma desiccation. The number of filled seeds/fruit, 100 seed weight, seed yield/fruit were significantly higher at 7.00 AM pollination in both the seasons. The number of unfilled seeds/fruit in summer (3.10) and *kharif* (4.10) was lower at 7.00 AM as compared to pollination at 9.00 AM and 11.00 AM. The fruit set and number of fruit developed to maturity were higher in naturally ventilated poly house and insect proof net house compared to open field condition in both the growing seasons, whereas number of filled seeds/fruit in summer (164.90) and *kharif* (197.86) under insect proof net house was higher than naturally ventilated poly house and open field condition. The insect proof net house and naturally ventilated poly house shown significantly higher 100 seed weight and seed yield per fruit compared to open field condition in both the growing seasons.

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Cucumber is basically monoecious in nature which means that there are both male and female flowers borne on the same plant. Male flowers occur in clusters with each flower on a slender stem and housing three stamens. Female flowers occur singly and are distinguishable by the large ovary at the flower base. However, gynoecious sex form is also found in which only female flowers are produced. Most cucumbers, whether monoecious or gynoecious, require insects to transfer pollen between flowers of the same or different plant. Fruit abortion can reach 100% in flowers bagged to exclude insect visitors, but self-pollination rates of 30-36% have been documented in the absence of insects (Gingras *et al.* 1).The exploitation of heterosis, has led to the development of hybrids, varies in a number of vegetable crops, including cucumber, bottle gourd, bitter gourd, musk melon etc. and hybrid seed has become popular among the vegetable growing farmers. In cucumber, hybrid seed production is performed manually and higher hybrid seed yield can be obtained from the seed parent if there is a perfect coincidence of stigma receptiveness and pollen viability. Thus, time of pollination plays a crucial role in hybrid seed production and pollination is done usually on the day of flower opening itself the stigma is receptive till noon of the day but most receptive in early morning. But success rate of pollination varies from 50 to 90% in cucumber hybrid seed production since transfer of male pollens to the female flowers through hand pollination during crossing period is the most sensitive aspect in large scale successful hybrid seed production in open field and very particularly in protected structures. Keeping in view of the above, the research experiment was carried out on standardizing the pollination time for optimizing the hybrid seed production under different growing environments, viz. naturally ventilated poly house, insect proof net house and open condition was studied. Whereas, published information in this aspect in protected structures is very limited. Therefore, present investigation was carried out to study the effect of pollination time on

fruit set and seed yield in hybrid seed production of cucumber cv. Pant Shankar Khira 1 in summer and *kharif* 2011.

The present investigation was carried out to during summer and *kharif* 2011 at Centre for Protected Cultivation Technology, Indian Agricultural Research Institute, New Delhi under three different growing environments, i.e. naturally ventilated poly house, insect proof net house and open condition using the seed parent and pollen parent of Pant Shankar Khira 1. The seeds of parental lines were obtained from Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The twenty days old seedlings were transplanted grown in plug tray using the artificial media with spacing 1 m × 0.6 m in all three conditions and other agronomic practices were followed uniformly. At flowering female flower buds of seed parent which will be opening next day morning are covered with butter paper bag having five to six tiny holes to facilitate the ventilation and avoid the build up of high temperature inside the butter paper bag in open condition to avoid bee visit however, the female flower bud under naturally ventilated poly house and insect

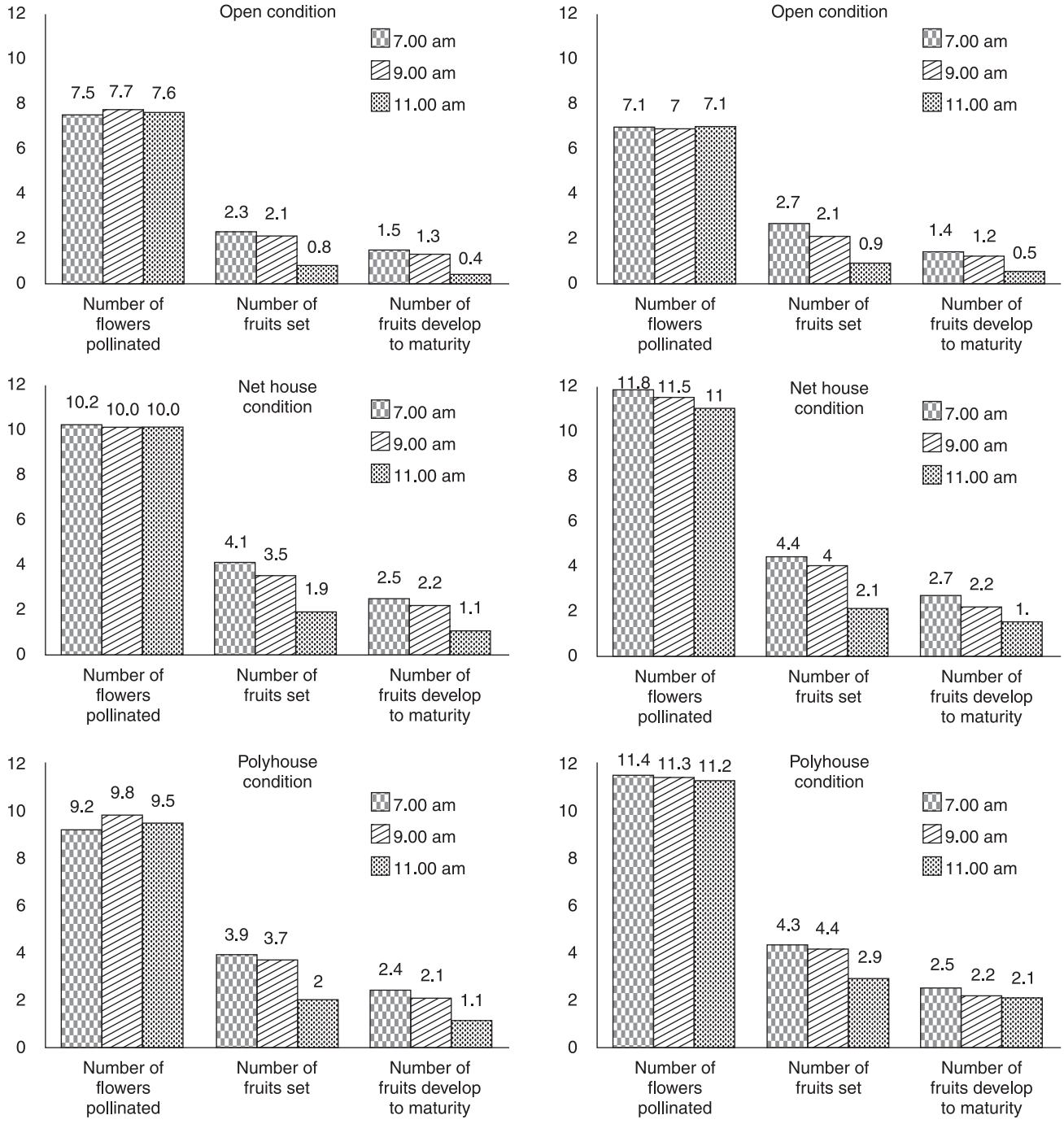

Fig 1 Effect of time of pollination and growing conditions on flowering behavior of cucumber (Pant Shankar khira 1) during summer and *kharif* 2011.

Table 1 Metrological observations during flowering period

Summer 2011					*Kharif* 2011				
Date		7 AM	9 AM	11 AM	Date		7 AM	9 AM	11 AM
05/04/2011	Temp. (°C)	18.8	21.0	26.5	03/09/2011	Temp. (°C)	26.6	28.1	30.6
	R. H. (%)	67.0	47.0	29.7		R. H. (%)	91.0	84.0	76.0
06/04/2011	Temp. (°C)	15.3	19.1	25.8	04/09/2011	Temp. (°C)	25.8	27.2	31.1
	R. H. (%)	72.0	50.0	22.3		R. H. (%)	90.0	85.0	81.0
07/04/2011	Temp. (°C)	15.0	18.8	25.6	05/09/2011	Temp. (°C)	24.0	26.1	29.5
	R. H. (%)	65.0	42.5	20.3		R. H. (%)	98.0	88.0	84.0
08/04/2011	Temp. (°C)	15.6	19.4	27.1	06/09/2011	Temp. (°C)	23.8	25.8	29.1
	R. H. (%)	63.0	40.1	28.8		R. H. (%)	97.0	90.0	88.0
09/04/2011	Temp. (°C)	17.2	21.7	27.2	07/09/2011	Temp. (°C)	24.4	26.3	30.2
	R. H. (%)	68.0	43.5	21.7		R. H. (%)	92.0	90.0	94.0
10/04/2011	Temp. (°C)	17.0	21.2	26.9	08/09/2011	Temp. (°C)	24.1	26.2	29.7
	R. H. (%)	83.0	59.1	32.1		R. H. (%)	95.0	84.0	76.0
11/04/2011	Temp. (°C)	17.8	21.9	26.5	09/09/2011	Temp. (°C)	23.9	25.5	28.6
	R. H. (%)	65.0	42.6	19.8		R. H. (%)	97.0	93.0	94.0
12/04/2011	Temp. (°C)	19.2	22.3	27.6	10/09/2011	Temp. (°C)	24.0	26.5	29.8
	R. H. (%)	77.0	47.5	23.8		R. H. (%)	97.0	85.0	80.0
13/04/2011	Temp. (°C)	18.4	22.8	27.9	11/09/2011	Temp. (°C)	24.5	27.1	30.2
	R. H. (%)	72.0	41.7	21.2		R. H. (%)	92.0	80.0	75.0
14/04/2011	Temp. (°C)	17.5	21.2	27.0	12/09/2011	Temp. (°C)	23.2	25.3	27.6
	R. H. (%)	71.0	44.1	22.3		R. H. (%)	90.0	82.0	73.0
15/04/2011	Temp. (°C)	18.4	22.5	28.2	13/09/2011	Temp. (°C)	23.3	25.1	28.5
	R. H. (%)	75.0	45.8	26.1		R. H. (%)	88.0	78.0	70.0
16/04/2011	Temp. (°C)	18.3	22.8	29.1	14/09/2011	Temp. (°C)	23.9	25.2	29.3
	R. H. (%)	62.0	40.5	20.3		R. H. (%)	86.0	75.0	72.0
17/04/2011	Temp. (°C)	19.6	23.2	28.6	15/09/2011	Temp. (°C)	23.5	26.1	28.8
	R. H. (%)	84.0	55.6	32.1		R. H. (%)	95.0	93.0	90.0
18/04/2011	Temp. (°C)	17.5	23.1	29.6	16/09/2011	Temp. (°C)	24.1	24.6	26.8
	R. H. (%)	71.0	46.8	29.0		R. H. (%)	97.0	95.0	85.0
19/04/2011	Temp. (°C)	17.4	20.5	25.4	17/09/2011	Temp. (°C)	24.3	25.5	28.9
	R. H. (%)	63.0	42.5	26.6		R. H. (%)	92.0	85.0	72.0
20/04/2011	Temp. (°C)	15.8	21.4	27.6	18/09/2011	Temp. (°C)	23.7	26.1	29.2
	R. H. (%)	56.0	39.2	20.1		R. H. (%)	90.0	82.0	75.0
21/04/2011	Temp. (°C)	17.4	22.5	28.3	19/09/2011	Temp. (°C)	23.4	26.5	29.1
	R. H. (%)	54.0	38.3	19.5		R. H. (%)	89.0	79.0	74.0
22/04/2011	Temp. (°C)	17.8	21.7	29.6	20/09/2011	Temp. (°C)	24.0	25.2	27.5
	R. H. (%)	58.0	39.1	20.6		R. H. (%)	90.0	85.0	80.0
23/04/2011	Temp. (°C)	18.3	22.7	30.1	21/09/2011	Temp. (°C)	24.1	25.7	29.1
	R. H. (%)	53.0	37.5	19.9		R. H. (%)	92.0	88.0	85.0
24/04/2011	Temp. (°C)	18.8	23.4	32.5	22/09/2011	Temp. (°C)	23.3	25.1	27.6
	R. H. (%)	61.0	41.3	25.2		R. H. (%)	88.0	85.0	75.0
25/04/2011	Temp. (°C)	19.6	24.1	33.6	23/09/2011	Temp. (°C)	23.5	26.1	28.9
	R. H. (%)	55.0	35.2	18.1		R. H. (%)	82.0	75.0	70.0
26/04/2011	Temp. (°C)	20.8	23.7	32.5	24/09/2011	Temp. (°C)	22.7	24.5	27.1
	R. H. (%)	46.0	32.1	17.2		R. H. (%)	84.0	74.0	68.0
27/04/2011	Temp. (°C)	21.4	23.6	33.1	25/09/2011	Temp. (°C)	22.5	25.1	28.6
	R. H. (%)	52.0	33.7	19.1		R. H. (%)	85.0	72.0	65.0
28/04/2011	Temp. (°C)	22.3	25.4	32.5	26/09/2011	Temp. (°C)	22.6	26.1	27.5
	R. H. (%)	48.0	32.1	18.7		R. H. (%)	80.0	75.0	66.0
29/04/2011	Temp. (°C)	23.7	26.1	33.8	27/09/2011	Temp. (°C)	23.4	25.7	28.9
	R. H. (%)	42.0	30.6	17.2		R. H. (%)	84.0	70.0	63.0
30/04/2011	Temp. (°C)	23.3	26.0	32.7	28/09/2011	Temp. (°C)	22.2	24.5	29.1
	R. H. (%)	40.0	28.5	17.1		R. H. (%)	80.0	72.0	65.0

proof net house conditions were protected. The male flowers were collected from the pollen parent block and female flowers were pollinated by hand. The female flowers were covered again with white butter paper bag in open condition only and tag is also placed with date of pollination. The pollination was performed in the three different conditions, viz. naturally ventilated polyhouse, insect proof net house and open field and with three timings, viz. 7.00 am, 9.00 am and 11.00 am regularly up to 30 days after initiation of flowering (05/04/2011-summer and 03/09/2011-*kharif*) and temperature and relative humidity at each pollination time throughout the growing period was noted and presented in Table 1.

Ten plants from each replication were selected at random and tagged for recording the observations on number of flowers pollinated, number of fruits set, number of fruit developed to maturity, number of filled seeds/fruit, number of unfilled seeds/fruit, 100 seed weight and seed yield/fruit. The experimental data recorded were statistically analysed as per the methods by employing SAS procedures using SAS version 9.2 adopting the analysis of variance technique appropriate to the level of treatments and the data were formulated. Critical differences were calculated whenever 'F' test was significant.

The results of the individual seasons of 2011 under three different growing environments are presented in Fig 1. Non-significant difference for number of flowers pollinated for 7 am, 9 am and 11 am were noted. However higher number of flowers were produced in *kharif* season compare to summer season and under naturally ventilated poly house and insect proof net house compare to open field condition because of congenial environment for growth and flowering in *kharif* as compared to summer. It is evident from the meteorological Table (Table 1) that in summer variation in diurnal temperature and relative humidity was more as compare to *kharif* which might have affected flower production, fruit set and fruit develop to maturity. The mean number of fruit set was highest at 7am (3.43-summer and 3.80-*kharif*) and lowest at 11am (1.56-summer and 1.96-*kharif*), similarly, mean number of fruit develop to maturity was highest at 7 am (2.13-summer and 2.20-*kharif*) and lowest at 11am (0.86-summer and 1.36-*kharif*). The fruit set in summer was less because at the end of the flowering period around 26/04/2011 the temperature increased to 21°C and relative humidity reduces to 50% which affected fruit setting significantly. However, in *kharif* season temperature reached up to 23°C during flowering period but relative humidity never reduced less than 70% this ensured more fruit set and develop to maturity during *kharif*. The number of fruit set and number of fruit develop to maturity were significantly higher under naturally ventilated polyhouse and insect proof net house compare to open field condition because of congenial environment for growth and flowering under protected structures. The increase in temperature and decrease in relative humidity at 11 am might have affected pollen viability and reduced the stigma receptivity thus reduced fruit set and fruit develop to maturity at 11 am in both the seasons was realised. The experiment results revealed that if temperature goes beyond 28°C and relative humidity less than 40% then fruit setting and fruit develop to maturity were affecting significantly. The results are in conformity with Hazra (2) who reported that in pumpkin must be the anthesis start at 5 am and the flower stay open unto 11.30 am, but hand pollination should be completed within 7.00 am to get more fruit set and fruit develop to maturity.

Non-significant difference for number of seeds/fruit when pollinated at 7 am, 9 am and 11 am, but, both the protected conditions, viz. naturally ventilated poly house and insect proof net house produced numerically higher numbers of seeds per fruit as compare to open field condition. The number of filled seeds was recorded significantly maximum in pollination time 7.00 am (150.56-summer and 170.03-*kharif*) compared to 9.00 am (146.90-summer and 171.55-*kharif*) and 11.00 am (141.70-summer and 161.13-*kharif*) Table 3. The number of unfilled seeds/fruit differed significantly due to pollination time. Significantly minimum number of unfilled seeds/fruit (3.10-summer and 4.10-*kharif*) was observed in pollination time 7.00 am compared to other pollination time. On the other hand, the maximum number of unfilled seeds/fruit 9.06-summer and 11.16-*kharif* were seen at 11.00 am pollination. Maximum number of unfilled seeds at 11 am might be because of unsuccessful pollination and fertilization due to increase in temperature and decrease in relative humidity (Table 1). The highest number of seeds/fruit was found under insect proof net house (170.56-summer and 204.63-*kharif*) followed by naturally ventilated polyhouse (168.16-summer and 200.36-*kharif*) then in open condition (117.96-summer and 121.80-*kharif*) and similar trend was observed for filled seeds/fruit. The 100 seed weight and seed yield/fruit were recorded significantly maximum at pollination time 7.00 am compared to 9.00 am and 11.00 am. The highest seed yield/fruit was observed in *kharif* season under naturally ventilated polyhouse at 7.00 am (6.03 g) while lowest found in summer season under open condition at 11.00 am (2.87g) Table 6. The results are in conformity with Shakti (3) who reported in cucumber cultivars Japanese Long Green, Khira 90 and Solan Local that anthesis started at 5 am and was complete by 8 am with the maximum anthesis occurring between 6 and 7 am in all 3 cultivars. Sundriyal *et al.* (4) reported 6.00 to 8.30 am has been appropriate time for hand pollination in bitter gourd for better fruit setting, fruit develop to maturity, more number of filled seeds more number of seeds/fruit and high seed yield/fruit.

SUMMARY

The pollination at 7.00 am proved as the best time for pollination in cucumber cv. Pant Shankar Khira 1 due to its significantly higher seed yield attributes in both the growing seasons and under all three growing environments. However, temperature beyond 28°C and relative humidity less than 40% are essential for fruit setting and affect significantly.

REFERENCES

Gingras D, Gingras J and Domingos D O. 1999. Visits of honeybees (Hymenoptera: Apidae) and their effects on cucumber yields in the field. *Journal of Economic Entomology* **92**(2): 435–8.

Hazra P. 2005. Seed production technology in pumpkin. (*In*) National Seminar on Cucurbits*,* 22-23 Sept, GBPUAT, Pantnagar, 121.

Shakti P S. 1990. Pollination and seed setting studies in cucumber (*Cucumis sativus* L.). *Vegetable Science* **17**(1): 99–101.

Sundriyal P, Singh D K and Gupta A K. 2005. Study of times interval response on fruit setting by hand pollination at different time interval in bitter gourd *(Momordica chanratia)*. (*In*) *National Seminar on Cucurbits,* 22-23 Sept, GBPUAT, Pantnagar, pp 76–7.