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Studies on yield and pest incidence of chilli (*Capsicum annuum* L.) grown under crop covers combined with transplanting dates

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Abstract
A field experiment was carried out during year 2021-22 at the Instructional Farm, Department of Vegetable Science, College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, to assess the effects of different transplanting dates and crop covers on the yield, yield attributing parameters and pest infestation of chilli. The experiment was laid out in a Factorial Randomized Block Design comprising twelve treatment combinations, each replicated three times. Treatments included three transplanting dates: T_1 (25th November), T_2 (10th December) and T_3 (25th December) and three crop cover thickness: *viz.*, C_1 (17 gsm), C_2 (20 gsm) and C_3 (23 gsm) and one control C_4 (without crop cover). Treatment combinations T_1C_1 (November 25 transplanting + 17 gsm crop cover) was found superior, significantly increasing yield attributing parameters such as number of fruits per plant, fruit weight, fruit yield per plant, fruit yield per plot, and fruit yield per hectare. Regarding pest incidence, the lowest thrips and whitefly populations were recorded on 25 December transplanting under 17 gsm crop cover (T_3C_1).

Keywords: Chilli, transplanting dates, crop cover

Introduction
Chilli (*Capsicum annuum* L.) which belongs to the Solanaceae family has grown into one of the most commercially important vegetable crops worldwide, followed by tomato. Economically, chilli is a good choice for generating higher income among the farming sector. Its yield and quality parameters play an important role in increasing the income of the farmers. Andhra Pradesh, Karnataka and Maharashtra are the three leading states in chilli production. Green chili is grown on about 410.9 thousand hectares in India, with an average productivity of 10.6 metric tonnes per hectare and 4363.2 thousand metric tons per year (Anon, 2021) [1].

The optimal planting date is the period during which environmental conditions collectively support the crop in achieving its maximum yield potential. Selecting the appropriate planting time ensures that the crop receives sufficient duration for germination, vegetative growth, flowering, and proper synchronization of reproductive stages with temperature. This alignment enables the crop to effectively utilize available light and favourable thermal conditions, ultimately enhancing yield quality (Nahardani *et al.* 2013) [9]. In green chilli, major sucking pests can inflict severe yield losses, often estimated between 50% and 90% (Nelson and Natrajan, 1994. Kumar 1995) [10, 6]. The application of non-woven crop covers has emerged as an effective strategy for managing Chilli Leaf Curl Virus. These covers represent an advanced agro-technological tool that offers physical protection, selectively filters sunlight, and restricts the entry of insect vectors. The use of crop covers induces several modifications in both the local microclimate and crop physiological activity. Such alterations influence CO_2 assimilation, thereby affecting crop growth and developmental patterns (Kittas *et al.* 2009) [5]. Terms like *crop covers*, *agro-textiles*, *non-woven fabric covers*, and *row fleece* are often used interchangeably to describe these protective materials.

Materials and Methods
A field experiment was carried out during the rabi-summer season of 2021-2022 at the

Instructional Farm of the Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The study employed a FRBD consisting of twelve treatment combinations, each replicated three times. The treatments included three crop cover thickness levels-C_1 (17 gsm), C_2 (20 gsm), and C_3 (23 gsm) along with a control (C_4) without any cover, and three transplanting dates: T_1 (November 25th), T_2 (December 10th), and T_3 (December 25th). Thirty days old seedlings of the chilli hybrid Arka Harita were transplanted at a spacing of 120 cm × 60 cm. After establishment seedlings covered with crop cover with the help of Galvanized wires and remains for 45 days after installation. In the study, yield parameters such as number of fruits per plant, fruit weight, fruit yield per plant, fruit yield per plot, fruit yield per hectare and thrips and white fly count at 45, 60, 90 and 120 days after transplanting from five tagged plants were recorded.

Result findings

Yield parameters

Date of transplanting and crop covers cause significant effect on number fruits per plant, fruit weight, fruit yield per plant, fruit yield per plot and fruit yield per hectare (Table 1, and 2).

A significantly higher number of fruits per plant (450.16) were observed in the crop transplanted on 25th November under the 17 gsm crop cover, compared to the crop transplanted on 25th December under open field conditions (401.83). The maximum fruits in the earliest transplanting date can be attributed to enhanced fruit set resulting from favorable weather conditions-particularly optimal temperature and humidity during the flowering period (Rawat *et al.* 2020) [13], (Kaur *et al.* 2018) [4]. The increase in fruit number per plant under the crop cover may also be due to improved growth and development of key yield-contributing traits. The protective covering enhances net photosynthesis and promotes greater assimilate production, thereby supplying more resources for fruit development (Kumar *et al.* 2017) [7].

The fruit weight of green chilli was highest (6.22 g) under the 17 gsm crop cover when seedlings were transplanted on 25th November, while the lowest fruit weight (5.45 g) was recorded under open field conditions with transplanting on 25th December. This improvement may be attributed to the favorable climatic conditions particularly optimal day and night temperatures prevailing during fruit development and setting, which enhance photosynthesis and mobilization of assimilates (Islam *et al.* 2017) [2]. An increase in fruit weight under crop cover conditions may also result from the improved microclimate provided by the covering compared to the open field (Manhas *et al.* 2023) [2].

The highest fruit yield per plant (2.80 g) and yield per plot (56.04 kg) were recorded in the treatment combination T_1C_1**,** corresponding to 25th November transplanting with a 17 gsm crop cover compared to the open condition without crop cover. This notable increase in yield might be attributed to favourable temperature regimes, an extended vegetative and reproductive growth period and minimal fluctuations between day and night temperatures during this stage (Madhumathi and Sadarunnisa 2013) [11]. The enhanced fruit yield per plant and per plot under the covered environment can also be associated with improved photosynthetic activity and greater accumulation of assimilates during the frost period, owing to the elevated temperature under the cover. These conditions collectively contributed to better plant growth and ultimately resulted in higher fruit productivity (Rawat *et al.* 2020) [13].

Hilli seedlings transplanted on 25th November under 17 gsm crop cover exhibited a significantly higher fruit yield (388.89 q/ha) compared to seedlings transplanted on 25th December under open-field conditions (323.61 q/ha). The enhanced yield associated with the November transplanting date may be attributed to the availability of favorable environmental conditions that support proper synchronization of flowering and its successful transition to fruit formation, thereby enabling the crop to achieve its optimum yield potential (Nahardani *et al.* 2013) [9]. The substantial enhancement in yield per hectare may also be linked to more conducive temperature regimes and the longer effective growth period available to the crop which collectively contributed to increased productivity (Iqbal *et al.* 2015) [3].

Table 1: Effect of date of transplanting and crop covers on number of fruits per plant, fruit weight, yield per plant, yield per plot and yield per hectare of chilli

Treatment	Number of fruits/plant	Fruit weight (g)	Fruit yield per plant (kg)	Fruit yield per plot (kg)	Fruit yield per hectare (q)
$T_1 C_1$	450.16	6.22	2.80	56.04	388.89
$T_1 C_2$	439.02	6.15	2.70	54.05	375.00
$T_1 C_3$	437.19	6.13	2.68	53.63	372.23
$T_1 C_4$	415.77	5.58	2.32	46.31	322.22
$T_2 C_1$	442.65	6.19	2.74	54.86	380.56
$T_2 C_2$	431.24	5.89	2.54	50.73	352.78
$T_2 C_3$	428.82	5.83	2.50	50.05	347.23
$T_2 C_4$	409.09	5.50	2.25	44.99	312.50
$T_3 C_1$	423.14	5.79	2.45	49.07	348.61
$T_3 C_2$	419.01	5.68	2.38	47.63	340.28
$T_3 C_3$	416.82	5.59	2.33	46.50	330.56
$T_3 C_4$	401.83	5.45	2.19	43.89	323.61
'F' test	Sig	Sig	Sig	Sig	Sig
SE (m) ±	5.31	0.13	0.43	0.78	6.68
CD @ 5%	15.58	0.39	1.29	2.29	19.60

Pest incidence

The thrips population count per three leaves per plant showed significant variation across transplanting dates and crop cover treatments at 45, 60, 90, and 120 DAT (Table 2).

The lowest thrips count 0.33 at 45 DAT and 4.75 at 120 DAT were recorded under the 17 gsm crop cover with 25th November transplanting, while the highest population (5.87 and 29.11) respectively were observed under open condition with 25th December transplanting. The markedly reduced thrips incidence under the 17 gsm cover attributed to the use of polypropylene non-woven fabric up to 45 DAT, which effectively restricts the entry of sucking pests and protects the crop during its vulnerable early growth stages (Salas *et al.* 2008) [14].

Transplanting on 25th November under 17 gsm crop cover resulted in the lowest whitefly populations, with counts of 0.24 at 45 and 19.96 at 120 DAT. Conversely, the highest whitefly population 15.41 at 45 and 38.43 at 120 DAT were recorded in the 25th December transplanting without crop cover. The reduced whitefly incidence in the early transplanted crop might be attributed to its escape from the initial phases of whitefly population development (Kethran *et al.* 2014) [8].

Table 2: Effect of date of transplanting and crop covers on thrips and white fly population count in chilli

	Thrips/three leaves/plant				White fly/three leaves/plant			
Treatment	**45 DAT**	**60 DAT**	**90 DAT**	**120 DAT**	**45 DAT**	**60 DAT**	**90 DAT**	**120 DAT**
$T_1 C_1$	0.33	1.95	3.76	4.75	0.24	1.33	12.8	19.96
$T_1 C_2$	0.37	2.06	3.93	4.97	0.27	1.4	13.26	22.17
$T_1 C_3$	0.38	2.14	4.05	5.10	0.28	1.45	14.05	23.10
$T_1 C_4$	5.72	11.29	22.83	27.45	12.51	15.43	21.15	32.46
$T_2 C_1$	0.35	1.97	3.93	4.88	0.25	1.36	13.06	21.55
$T_2 C_2$	0.39	2.21	4.18	5.56	0.30	1.53	15.27	23.38
$T_2 C_3$	0.40	2.30	5.49	5.85	0.30	1.59	15.96	24.11
$T_2 C_4$	5.80	13.26	23.55	28.13	13.65	16.52	23.8	35.76
$T_3 C_1$	0.40	3.46	4.83	5.93	0.32	1.63	16.35	25.48
$T_3 C_2$	0.42	3.73	4.98	6.08	0.33	1.66	16.88	26.09
$T_3 C_3$	0.43	3.80	5.09	6.15	0.35	1.73	17.10	26.55
$T_3 C_4$	5.87	14.05	25.78	29.11	15.41	17.59	24.31	38.43
‘F’ test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.04	0.24	0.29	0.12	0.20	0.16	0.40	0.12
CD @ 5%	0.12	0.71	0.84	0.36	0.58	0.48	1.18	0.36

Conclusion

The findings of this study clearly demonstrate that the date of transplanting and the thickness of the crop cover play a pivotal role in optimizing yield and minimizing pest incidence of green chilli.

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