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Influence of different agrochemicals on yield atributes & yield of chilli (*Capsicum annuum* L.) grown under HK region of Karnataka

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Abstract
A field experiment was conducted at Agriculture college farm Raichur, University of Agricultural Sciences, Raichur, Karnataka to study the influence of different agrochemicals on morphological parameters and yield and yield components of chilli variety. The experiment was laid out in randomized complete block design with 3 replications during *kharif* season 2018. The experiment consisting of 9 different agrochemicals treatment along with a control *i.e.*, T_1: Gibberellic Acid (GA_3) @10 ppm, T_2: Naphthalene acetic acid (NAA) @10 ppm, T_3: Methyl Jasmonates (Me JA) @ 0.5mM, T_4: $T_2 + T_3$, T_5: Cycocel @ 1000 ppm, T_6: Nitrobenzene @ 10 ppm), T_7: Brassinosteroides @ 0.15%, T_8: T_5+ T_7, T_9: Control. Among the treatments, NAA @ 10ppm recorded significantly higher number of fruits (146.33) over all other treatments followed by GA_3 and Brassinosteroids (137.67 and 135.33). However, the treatments CCC, Nitrobenzene and combination of CCC and brassinosteriods (128.33, 106.00 and 106.67) did not differ significantly among themselves. Lowest yields (50.67) were recorded in control. However, the treatments GA_3 and brassinosteriods and CCC were on par with each other. The treatment NAA @ 10ppm recorded significantly higher number of fruits (9.42 cm) followed by GA_3 (9.13 cm) and Brassinosteriods (8.46 cm). However, the treatments CCC (8.41 cm), Nitrobenzene (8.18 cm) and combination of CCC and brassinosteriods (8.17 cm) did not differ significantly among themselves. The treatment NAA @ 10ppm recorded significantly higher yield (904 kg ha^{-1}) over all other treatments followed by GA_3 and Brassinosteriods 855 and 847 kg ha^{-1}, respectively. However, the lowest yield (496.67 kg ha^{-1}) was recorded in control.

Keywords: Agrochemicals, foliar application, yield

Introduction
The chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop grown in almost all parts of tropical and subtropical regions of the world. It was first introduced in India by Portuguese towards the end of 15^{th} century. It belongs to the family solanaceae and originated from South and Central America where it was domesticated around 7000 BC. The genus capsicum includes 30 species, five of which are cultivated *viz.*, *Capsicum annuum* L., C. *frutescens* L., C. *Chinense jacq*, C. *pubescens* and C. *baccatum* L. (Bosland and Votava, 2000, Wang and Bosland, 2006 and Ince *et al.*, 2010) [4, 17]. *Capsicum annum* is cultivated either for pungent fruited genotypes called chilli (synonyms: hot pepper, American pepper, azi, cayenne, paprika etc.) or non-pungent fruited genotypes called sweet pepper (synonyms: Capsicum, paprika, bell pepper, Shimla mirchi). Being a crop of tropical and sub-tropical regions, it requires warm humid climate. It is grown throughout the year all over the contry in india. Chilli has many culinary advantages. It comprises numerous chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, proteins, fibres and mineral elements (Bosland and Votava, 2000) [4]. Capsicum fruits may serve as a source of natural bactericidal agents to be used in food and medicinal systems. Besides conventional nutritional food uses, a number of versatile food (paprika oleoresin) and non-food (defense, spiritual, ethno botanical) uses of chillies are known Meghavansi *et al.*, 2010).

In India chilli occupies an area of 3.09 lakh hectares with an annual production of 35.92 lakh tonnes. In India, major chilli producing states are Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Madhya Pradesh (Agriwatch, 2017) [1] Karnataka stands third in area (1.02 lakh hectares) and production (1.03 lakh tones), while in productivity it ranks twelth in position (Anon, 2018) [2].

The important chilli growing districts in Karnataka are Haveri, Dharwad, Gadag, Koppal, Belgaum, Bellary and Raichur of which Haveri and Dharwad districts themselves make up 72 and 60 per cent of total area and production, respectively. In recent years, there has been a great demand for increasing the diversity in chilli for both culinary and ornamental purposes. In chilli, flower abscission will be high if day temperature is in the range of 32-38 ºC, whereas fruit retention will be maximal at 16-21 ºC day temperature. As compared to other crops, chilli plants do not appear to suffer from leaf injury and grow normally even under continuous light (Demers *et al.*, 1994). Study on chilli has revealed that great variation exists in ability of flowering, fruit set, yield and other qualitative attributes under different agro-climatic regions (Wien, 1989, Rani, 1996 and Gupta, 2003) [11]. High temperature reduces percent fruit set as well as size of fruits (Sahu, 2010). It affects several physiological and biochemical processes of the plant leading to impaired growth and reproduction, shortens life cycle by hastening flowering and maturity; reduces yield and quality of fruits. Hot pepper requires comparatively a longer growing season and fruit setting is drastically reduced if dry weather is accompanied by high temperature.

There is a great potential to increase yield of chilli by reducing the flower and fruit drops further by increasing the fruit set. A group of chemicals known as plant growth regulators, plant hormones and growth inhibitors are known to have many practical controlling implications in growth and many other physiological activities and metabolic processes of the plants. Plant growth regulators are considered as new generation of agro-chemicals after fertilizers, pesticides and herbicides to augment seed yield and quality. In hot regions, there is a great problem of premature flower and fruit drop in chilli due to hormonal imbalance and this becomes more problematic when there is a sudden rise in atmospheric temperature. Use of plant growth substances in optimum concentration regulates growth, fruitfulness and yield. Moreover, the use of these substances improves the quality traits like capsaicin, ascorbic acid, carbohydrate and protein content. It is therefore, the use of plant growth regulator has proved as a boon for improving the growth, yield and quality. Keeping in mind the threats to chilli production and the possible impact of growth hormones on production by reducing the flower and fruit drop, the the experiment has been planned.

Materials and Method

Three tagged plants used for recording morphological observations which were harvested at physiological maturity and were used for recording the following yield and yield components. The length of five randomly selected fruits was measured from the base of pedicel to the tip of the fruit and average was worked out and expressed in centimeters. Fruits was picked at mature stage till they attained constant weight from tagged plants in each plot. The total weights of riponed fruits were recorded and mean fruit yield plant^{-1} was calculated and expressed in grams. The fruit yield obtained from each picking from the net plot area was matured till they attained constant weight and the total weight of fruits was recorded. Based on the riponed fruit yield from the net plot area, the yield per hectare was computed and expressed in kgsha^{-1}.

The harvest index is defined as the ratio of economic yield to total biological yield and expressed in per cent.

Results and Discussion

The data on number of fruits per plant indicated that among the treatments, NAA @ 10 ppm recorded significantly higher number of fruits (146.33) over all other treatments followed by GA_3 and Brassinosteroids (137.67 and 135.33). However, the treatments CCC, Nitrobenzene and combination of CCC and brassinosteriods (128.33, 106.00 and 106.67) did not differ significantly among themselves. Lowest yields (50.67) were recorded in control. However, the treatments GA_3 and brassinosteriods and CCC were on par with each other. The fruit length between the treatments NAA @ 10ppm recorded significantly higher number of fruits (9.42 cm) followed by GA_3 (9.13 cm) and Brassinosteriods (8.46 cm). However, the treatments CCC (8.41 cm), Nitrobenzene (8.18 cm) and combination of CCC and brassinosteriods (8.17 cm) did not differ significantly among themselves. While the shortest was recorded in control (7.69 cm). The data on number of yield per plant Indicated significant differences between the treatments. Among the treatments, NAA @ 10ppm recorded significantly higher yield per plant (1057.20 g) as compared to all other treatment followed by GA_3 and Brassinosteriods (903.5 and 852.51 g). However, the lowest yields were recorded in control treatment (493.14 g). However, the treatments GA_3 and brassinosteriods were on par with each other.

The data on Yield per hactor indicated that among the treatments, NAA @ 10 ppm recorded significantly higher yield (904 kg ha^{-1}) over all other treatments followed by GA_3 and Brassinosteriods 855 and 847 kg ha^{-1}, respectively. However, the lowest yield (496.67 kg ha^{-1}) was recorded in control. However, the treatments GA_3 and brassinosteriods and Cycocel were on par with each other. The fruit yield and number of fruits per plant varied significantly between the treatments. Among the treatments NAA @ 10 ppm recorded significantly higher fruit yield over the control. The increase in yield in T_2 could be attributed to the manifestation of various growth, biophysical and biochemical parameters studied. Among the treatments, NAA recorded the maximum increase in fruit yield (146.33) followed by GA_3 (137.67). In addition, Brassinosteroids, CCC, Nitrobenzene also showed substantial increase in fruit yield compared to control, which could be due to their influence on photosynthetic rate, stomatal conductance and chlorophyll. The increase in number of fruits per plant by NAA was reported by Mehrotra *et al.* (1970) [5] in tomato, Lyngdon and Sanyal (1992) [4] in capsicum and Kanthaswamy (2006) [3] in moringa. Our results are in similarity with the findings of Suryanarayans and Arifuddin (1978) [8], Bighnaraj *et al.* (2016) [1] and Wallet and Raines 2011 [10] who reported that increase in fruit yield due to the application of plant growth regulators in C_3 plants.

Conclusion

On the basis of present investigation, the following conclusion can be drawn that the plant growth regulators played a vital role in internal mechanism of plant growth and development by interacting with key metabolic processes there by optimizing the source-sink relation in plant and stimulate the translocation of photo assimilates to the sink.

Among the plant growth regulators, the treatment NAA 10 ppm was found effective in increasing the yield of marketable fruits in chilli and more effective in increasing number of fruits per plant (Plate 5) followed by GA_3 in chilli crop.

Table 1: Yield and yield components as influenced by foliar spray of PGRs in Chilli crop

Treatments	NDVI value	Leaf area(dm^2)	No. of fruits plant^{-1}	Fruit length (cm)	Yield (g plant^{-1})	Yield (kg ha^{-1})
T_1- Gibberellic Acid (GA_3) @ 10 ppm	0.73	96.70	137.67	9.13	903.53	855.41
T_2- Naphthalene acetic acid (NAA) @ 10 ppm	0.76	98.90	146.33	9.42	1057.20	904.21
T_3- Methyl Jasmonates (Me JA) @ 0.5 mM	0.68	93.87	106.67	8.17	682.23	753.00
T_4-T_2+T_3	0.69	93.77	77.67	8.12	560.87	724.67
T_5- Cycocel @ 1000 ppm	0.72	95.53	128.33	8.41	744.39	827.33
T_6-Nitrobenzene @ 10 ppm	0.71	94.23	106	8.18	714.23	765.67
T_7- Brassinosteroides @ 0.15%	0.72	96.37	135.33	8.46	852.51	847.67
T_8- T_5 + T_7	0.69	93.83	108.33	8.13	674.17	726.37
T_9-Control	0.68	78.77	50.67	7.69	493.14	496.67
Mean	0.71	93.56	110.78	8.41	747.83	744.52
S.Em(±)	0.01	0.63	1.12	0.01	35.00	1.12
C.D at 5%	0.02	1.18	1.36	0.03	104.92	3.36

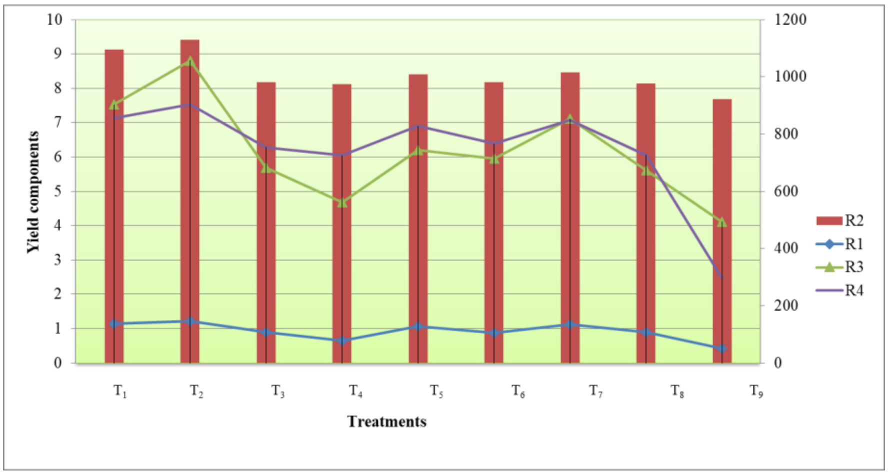

Fig 1: Yield and yield components as influenced by foliar spray of PGRs at different growth stages in Chilli

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