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EFFECT OF POLYETHYLENE COATED CALCIUM CARBIDE ON PHYSIOLOGY, PHOTOSYNTHESIS, GROWTH AND YIELD OF SWEET PEPPER

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Polyethylene coated calcium carbide (PCC) is a potent and continuous slowly releasing source of acetylene and ethylene. It potentially improves plant growth by affecting physiology of plant. A pot study was conducted to investigate comparative effects of different rates of PCC on growth and yield attributes of sweet pepper. PCC performed better when applied with soil applied fertilizers. Results revealed that hormonal properties of calcium carbide significantly influenced physiological nutrient use efficiency and vegetative growth by affecting photosynthetic and physiological parameters of sweet pepper. Application of 20 mg PCC kg^{-1} soil with soil applied recommended dose of NPK fertilizers significantly improved the net photosynthetic rate by 32%, stomatal conductance by 11%, transpiration rate by 14%, carboxylation efficiency by 47%, physiological water use efficiency by 13%, physiological nitrogen use efficiency by 29% over the control treatment. This improvement in physiological attributes resulted in increase in leaf area by 20%, leaf area index by 78%, total plant dry weight by 35%, flower and fruits by 29% and fruit yield by 24% compared to the treatment of alone recommended dose of NPK fertilizers. Present study suggests that application of PCC particularly at the rate of 20mg PCC kg^{-1} soil plus recommended dose of NPK fertilizers improved about 25% sweet pepper production compared to its production in the alone recommended fertilizer treatment.

Keywords: Acetylene, Ethylene, Nitrogen Use Efficiency; Photosynthesis; Sweet pepper

INTRODUCTION

Sweet pepper (*Capsicum annuum* L.), also known as bell pepper, is one of the most important vegetable not only in Pakistan but also throughout the world. It is a popular home garden vegetable. It is a good source of vitamins such as Thiamine (vitamin B1), Riboflavin (vitamin B2), Niacin (vitamin B3), Pantothenic acid (B5), pyridoxal phosphate (vitamin B6), Folate (vitamin B9), Vitamin C and minerals like calcium, iron, magnesium, phosphorus, potassium and zinc (USDA, 2012). Its cultivation brings remunerative income to small farmers of Punjab and Sindh Provinces of Pakistan. According to Economic Survey of Pakistan, production of sweet pepper per unit area in Pakistan is quite less than that of neighbouring countries (GOP, 2012). Although, progressive farmers are following improved sweet pepper technology such as use of hybrid seeds, balance use of fertilizers, production under tunnel, but still they cannot get potential yield of sweet pepper. On the other side, the demand for sweet pepper is rising as it is one of main vegetable being used in different food recipes especially in pizza industry. Moreover, great losses in yield and quality due to diseases have also been reported for sweet pepper (Rahimi *et al*., 2013). Therefore, decline in sweet pepper production is becoming a burning issue for the future of Pakistan where area under pepper production is declining quickly while demand is rising day by bay (GOP, 2012). Therefore, there is need to integrate nonconventional approaches in conventional approaches to avoid losses in yield by regulating plant growth. This will be helpful to narrow down yield gap between potential yield of cultivar and farmers' obtained yield.

Among nonconventional approaches, use of plant growth regulators (phytohormones) such as ethylene, salicylic acid, auxin, cytokinin, jasmonic acid, brassinolide, gibberellic acid, abscisic acid have key importance as these regulate crop productivity due to their specific role in plant physiology. After comprehensive studies of their mechanism of action in crop physiology, some of them can be used for filling up gap generated between potential and actual yield of sweet pepper (Nickell, 1994; -Siddiq *et al*., 2012). Ethylene is an important gaseous hormone and is known as ripening hormone (Morgan and Dew, 1997). It plays unique role in plant physiology (Nicolas *et al.*, 2001; Alexander and Gierson, 2002). It is responsible for early fruiting, fruit ripening, early onset of reproductive growth and early plant maturity (Bebawi and Eplee, 1986; Seneweera *et al.*, 2003). Its exogenous application has been reported to improve crop yields (Steffens *et al.*, 2005). Moreover, it is responsible for induction of horizontal plant growth that leads to more number of branches and fruits per plant (Mattoo and Suttle, 1991).To promote exogenous ethylene use for boosting up agricultural productivity, 'Ethephon' and 'Retprol' were developed in the past and marvelous increase in crop yields had been reported due to application of these products. Bibik *et al*. (1995) and Muromtsev *et al.* (1988) reported 50 to 70% rise in potato and, tomato yield due to application of Ethephon. Recently, calcium carbide (CaC_2) has been identified as an excellent source of exogenous ethylene. It can an effective and reliable source of exogenous ethylene when it is coated with some suitable coating material. It releases acetylene (Yaseen *et al.*, 2012) in soil that later on converted into ethylene by microbial activity (Muromtsev *et al.*, 1988). Both of these gases also act as nitrification inhibitor which inhibit oxidation of NH_4^+ by inhibiting activity of ammonia-oxidizing enzyme involved in the nitrification and denitrification (Sahrawat, 1987; Keerthisinghe *et al.*, 1996). Calcium carbide being source of acetylene and ethylene can promote plant growth and yield of crops more than other sources (Muromtsev *et al.*, 1991; Mahmood *et al*., 2009; Siddiq *et al*., 2012). Soil application of coated/encapsulated CaC_2 with recommended dose of fertilizers not only resulted in early flowering but also brought early fruiting and maturity with significant increase in tomato (Siddiq *et al*., 2012), okra (Kashif *et al*., 2012), cucumber (Shakir *et al*., 2012) and wheat (Ahmad *et al.*, 2012) yields. However, no work related to effect of polyethylene coated CaC_2 (PCC) on morphological characteristics, photosynthesis, nitrogen use efficiency and yield attribute of sweet pepper has been reported. Keeping these facts in mind, a pot study was planned to investigate comparative effects of different rates of PCC on nutrient use efficiency, photosynthetic and morphological characteristics and yield attributes of sweet pepper (*Capsicum annum* L.).

MATERIALS AND MATHODS

A pot study was conducted at wire-house of Institute of Soil & Environmental Sciences, University of Agriculture Faisalabad, Pakistan to investigate the effect of polyethylene-coated calcium carbide (PCC) on growth parameters, morphological characteristics and yield of sweet pepper. The study was planned according to factorial completely randomized design (CRD) with four replications. The treatment plan included 0, 10, 20, 30 and 40 mg PCC kg^{-1} soil with 0-0-0 and 120-75-60 kg ha^{-1} N, P and K. Soil collected from the Research Area of the Institute was used for filling the pots. The soil was thoroughly mixed, air dried, passed through 2mm sieve and analyzed for physicochemical characteristics before use (Table 1). The prepared soil (12 kg) was filled in each pot. Nursery of sweet pepper cv. Yolo Wonder was raised in inert sand washed with distilled water. Thirty days old two seedlings were transplanted per pot. However, one plant was retained per pot after successful establishment of seedling. Uprooted seedling was chopped and incorporated in the same pot. For NPK fertilizers, nitrogen as urea, phosphorous as diammonium phosphate and potassium as muriate of potash was applied in soil according to treatment plan. One third N and full P and K was applied before transplanting seedlings whereas remaining N was added to relevant pots four weeks after nursery transplanting. The position of pots was randomly changed after every 72 h.

Data concerning to growth and yield parameters was documented at different growth stages. Parameters like Photosynthetic rate, transpiration rate, internal CO_2 concentration in leaf, stomatal conductance from the fully expanded young leaves on all sides of plant was recorded 80 days after transplanting with the help of LCI Portable Photosynthesis System. All the values were then averaged. Leaf area was recorded by leaf area meter.

The shoot, root and fruit samples were taken for nutrient analysis. Samples were carefully and rapidly washed three times with de-ionized water for 30 seconds, and then dried at 60^oC for 48 in a forced air-driven oven (1370 F, Sheldon Manufacturing Inc. Portland Oregon). Ground samples were obtained on a Quadrumat Junior mill. A subsample of plant material was digested in a di-acid (2:1 HNO_3:$HClO_4$) mixture (Jones *et al*., 2012). The N concentration in plant samples was analysed by the micro-Kjeldahl procedure after digestion with H_2SO_4-H_2O_2. Nitrogen was analysed according to Jackson *et al*. (1962) while for phosphorus; vanadate-molybdate spectrophotometric procedure was used. Potassium was determined by flame photometer (Chapman

Table 1. Physico-chemical characteristics of soil used for filling pots

Parameter	Value	Parameter	Value
Sand	51.25%	CO_3^{--}	13 ± 5 me L^{-1}
Silt	30.33%	HCO_3^-	0.79 ± 0.2 me L^{-1}
Clay	18.42%	Cl^-	13.2 ± 0.3 me L^{-1}
Textural class	Sandy clay loam	SO_4^{--}	10.2 ± 0.1 me L^{-1}
Saturation	34 ± 3%	Na^+	15.1 ± 0.4 me L^{-1}
pHs	8.1 ± 0.3	Ca^{++} + Mg^{++}	8.22 ± 1.10 me L^{-1}
ECs	2.45± 0.5 dS m^{-1}	Total N	0.029 ± 0.004%
CEC	4.31 $cmol_c$ kg^{-1} soil	Available P	5.94 ± 0.9 mg kg^{-1} soil
Organic matter	0.55± 0.05%	Extractable K	139 ± 8 mg kg^{-1} soil

et al., 1961).

Carboxylation efficiency was calculated as the ratio of photosynthesis to intercellular CO_2 concentration while photosynthetic water use efficiency was calculated as the ratio of photosynthesis to stomatal conductance (Khan *et al.*, 1961). Leaf area index (LAI) and leaf area ratio (LAR) was calculated as reported by Rahman and Inden (2012). The physiological nutrient use efficiency was calculated by using following formula (Yaseen *et al*., 2012).

$$\text{Physiological nutrient use effeciency} = \frac{\text{Yiled in treated plot} - \text{Yield in control}}{\text{Nutrient uptake treated plot} - \text{Nutrient uptake in control}}$$

Data was analysed by using the Statistix 8® computer program for computing analysis of variance while means were compared by Least Significant Difference test at 5% level of probability (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

***Photosynthetic Parameters*:** Application of different rates of polyethylene coated calcium carbide (PCC) had marked influence on different physiological parameters like photosynthetic activity, transpiration rate, stomatal conductance and internal CO_2 concentration. Application of PCC highly significantly increased ($P < 0.001$) net photosynthetic rate, exhibiting quadratic ($P < 0.001$) effects of application rate (Figure 1a). Combined application of PCC and NKP fertilizers enhanced about 22 to 32% net photosynthesis over that in the treatment of alone NPK fertilizers. However, highest net photosynthetic rate (12.73μmol $m^{-2}s^{-1}$) was observed in the treatment of 20 mg PCC kg^{-1}soil plus NPK fertilizers (Figure 1a). The quadratic change in photosynthetic rate might be due to antagonistic effect of higher concentration of gases particularly ethylene released from PCC on photosynthesis (Alexander *et al.*, 2002). Stomatal conductance adopted a cubic trend of variation and its highest value was noted in the treatment of 10 mg PCC kg^{-1} soil, followed by 20 and 40 mg kg^{-1} (Figure 1b). Therefore, stomatal conductance followed decreasing trend with increase in the rate of application of PCC. Similarly, with increasing rates of PCC, transpiration rates as well as internal CO_2 concentrations also exhibited cubic variations (Figure 1c, 1d). These variations might be due to change in physiologically active concentrations of ethylene in plant tissue (Morgan and Dew, 1997; Steffens *et al.*, 2005; Yaseen *et al.*, 2012).

***Physiological Parameters*:** Physiological water, CO_2 and nutrient use efficiencies were significantly ($P < 0.001$) influenced by the application of PCC (Figure 2), however, quite variation was observed in the response of these parameters to the application of different rates of PCC, i.e. Carboxylation efficiency showed quadratic trend (Figure 2b) while photosynthetic water use efficiency (PWUE) showed cubic trend (Figure 2a). Application of 20 and 30 mg kg^{-1} soil PCC improved PWUE by 11 to 13%, respectively compared to the treatment of NPK fertilizer alone. The highest PWUE was recorded at 20 mg PCC kg^{-1} soil. About 11 to 47% more carboxylation efficiency in combined treatment of PCC plus NPK fertilizers highlighted the effective changes in physiological processes of plant due to the released acetylene and/or ethylene from PCC (Figure 2b). Enhanced carboxylation efficiency in response to applied PCC determines the mesophyll effects that is characterized as a product of CO_2 binding capacity and the electron transport capacity. The effect of PCC based ethylene on photosynthesis was also strengthened by the increase in photosynthetic water use efficiency, which has influence on plant water use efficiency and associated with higher Rubisco activity or rate of electron transport.

Decrease in physiological nutrient use efficiency was agreed to as reported for tomato due to application of coated calcium carbide compared to control (Yaseen *et al*., 2005, 2012) (Figure 2c). Among NPK containing treatments, the lowest value of physiological nitrogen use efficiency (PNUE) was found in the 20 mg PCC kg^{-1}soil treatment that was 29% less than that of control, therefore, the highest PNUE was found in the control treatment (Figure 2c). Similar variations in physiological potassium use efficiency (PKUE) and physiological phosphorus use efficiency (PPUE) were observed due to different rates of PCC (Figure 2c). These positive changes in physiological nutrient use efficiency might be either nitrification inhibitory effect of acetylene to prolong the availability of nitrogen or hormonal action of ethylene released from PCC. Both the gases might have effect on fruit quality of sweet pepper. Kashif *et al*. (2012) and Yaseen *et al*. (2012) also reported improvement in fruit quality attributes under coated calcium carbide along with soil applied NPK fertilizers.

***Growth Analysis*:** Growth parameters differed significantly ($P < 0.001$) by PCC rates and NPK fertilizers (Table 2). Although, all rates of PCC influenced leaf area (LA), however, PCC application rates 10 to 40 mg kg^{-1} soil when added with NPK fertilizers improved 16 to 20% LA. This increase in LA resulted in 10 to 78% increase in leaf area index (LAI). However, there was increase in LA and LAI upto 20 mg PCC, then LA and LAI were decreased at 30 and 40 mg kg^{-1} soil PCC rates (Table 2). Higher LA is one of the key criteria for producing higher metabolites. Previously, it is proven that plants with high LA has more ability to intercept light for the production of metabolites (Prieto *et al*., 2007). Higher LA and LAI of PCC treated plants might be due to high physiological N use efficiency (Figure 2c). This efficiency would develop ability in plant to produce higher metabolites in plant. In PCC treated plants, decrease in leaf area to mass ratio (LAR) provided better-nourished plants than plants supplied with fertilizer only i.e. in control treatment. However, higher rates of PCC (30 and 40 mg kg^{-1} soil) failed to contribute more metabolites in leaves and thus led to comparatively higher LAR than lower rates of PCC.

Table 2. Main and interactive effects of different rates of polyethylene coated calcium carbide and NPK fertilizers on dry matter partition, LA, LAR and LAI of sweet pepper (Each value is mean of 4 replications)

Treatments		Plant dry biomass (g plant^{-1})				LA	LAI	LAR
		Root	Leaf plus stem	Fruit	Total			
Main Effect								
mg PCC		8.58 c	24.0 d	13.18 d	45.76 d	37.1 c	0.38 d	64.8 a
kg^{-1} soil	10	9.38 b	32.7 c	17.99 c	60.12 c	39.9 b	0.47c	53.3c
	20	10.30a	38.1 a	20.95 a	69.38 a	45.0 a	0.66a	61.8ab
	30	9.51 b	36.7 b	20.15 b	66.32 b	43.3 a	0.56b	55.1bc
	40	9.23 b	36.1b	19.84 b	65.19 b	38.8 bc	0.44cd	44.6d
NPK	0-0-0	6.44 b	15.8b	8.67 b	30.89 b	38.8 b	0.37 b	72.3a
	120-75-60	12.36 a	51.3a	28.18 a	91.81 a	42.9 a	0.63 a	39.5b
Interaction								
NPK	PCC							
0-0-0	0	6.34 d	7.4 g	4.07 g	17.82 g	35.1	0.28 g	91.7a
0-0-0	10	6.45 d	18.9 e	10.36 e	35.68 e	41.2	0.42ef	69.1b
0-0-0	20	6.42 d	14.6 f	8.01 f	29.01 f	37.7	0.35fg	69.1 b
0-0-0	30	6.69 d	19.4 e	10.68 e	36.82 e	43.0	0.47de	75.0b
0-0-0	40	6.30 d	18.6 e	10.22 e	35.13 e	36.9	0.34fg	56.7c
120-75-60	0	10.82 c	40.6d	22.30 d	73.70 d	39.1	0.48de	37.8de
120-75-60	10	12.34 b	50.9 c	27.97 c	91.22 c	42.2	0.59c	37.5de
120-75-60	20	13.91 a	56.8 a	31.22a	101.94a	46.9	0.85a	48.6cd
120-75-60	30	12.56 b	54.5 b	29.93 b	96.95 b	45.4	0.69b	41.2de
120-75-60	40	12.16 b	53.6 b	29.46b	95.25 b	40.7	0.53cd	32.4e
Significance								
PCC		**	**	**	**	**	**	**
NPK		**	**	**	**	**	**	**
NPK × PCC		**	*	*	**	NS	*	**

Values sharing same letter(s) in each column do not differ at $p < 0.05$ according to LSD test, *Significant at $p < 0.05$, **Highly significant at $p < 0.01$, NS Non-significant at $p < 0.05$, 120-75-60 = NPK fertilizer rates as120 kg N ha^{-1}, 75 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}., PCC = Polyethylene coated calcium carbide.

Results suggest that mild stress on plant might have occurred due to excessive release of ethylene from higher rates of calcium carbide, which adversely affects plant growth (Siddiq *et al.*, 2012). However, plant growth parameters indicated that application of PCC at 20 mg kg^{-1} soil supported a plant growth in a better way.

***Plant Dry Weight*: **Data on root, stem, fruit and final total plant dry weights of sweet pepper exhibit significantly ($P < 0.001$) of PCC rate, soil applied NPK fertilizers and their interaction (Table 2). Plant biomass multiplied with increase in rate of PCC but the trend of this increase was quadratic. This trend might be due to excessive release of higher acetylene and ethylene from 30 and 40 mg PCC compared to 10 and 20 mg PCC treatments. Thus higher rates of PCC contributed to lower dry weights (Table 2). Among all rates of PCC, 20 mg PCC kg^{-1} soil in the presence of NPK fertilizers produced about 35% more dry weights of roots, stems and fruits compared to the NPK fertilizer alone application (Figure 1,2). Recently reported work on coated calcium carbide also revealed this phenomenon about variations in plant dry weights and mineral contents in plant tissues due to higher rates of calcium carbide (Kashif *et al.*, 2012; Ahmad *et al.*, 2012). Seneweera *et al.* (2003) reported that shoot and root dry weights decreased on higher concentrations of ethylene.

***Vegetative Growth*: **Results in Table 3 show that vegetative growth of capsicum (plant height, number of leaves and branches plant^{-1}) was significantly affected by different rates of PCC treatments, NPK fertilizers and their interaction except treatment interaction for number of leaves. Plant height consistently decreased with increasing rate of PCC (Table 3). However, number of leaves and branches per plant increased with increasing rate of PCC up to some rates then declined at higher rates. The highest total plant height (66 cm) was recorded in fertilizer alone treatment but the lowest number of branches (9.8) and leaves per plant (110) were also observed in this treatment. However, application of PCC reduced plant height from 10 to 21% while increased number of branches and leaves per plant from 11 to 32% and 6 to 48% compared to respective values in NPK fertilizer alone treatment, respectively. These results revealed that vegetative growth parameters were strongly affected by the

Table 3. Main and interactive effects of different rates of polyethylene coated calcium carbide and NPK fertilizers on vegetative growth, yield attributes and yield of sweet pepper (Each value is mean of 4 replications)

Treatments		Plant height (cm)	No. of Leaves $plant^{-1}$	No. of Flower $plant^{-1}$	No. of fruits $plant^{-1}$	No. of Branches $plant^{-1}$	Fruit yield (g $plant^{-1}$)
Main Effect							
mg PCC	0	62 a	91 d	26.0 c	10.6	8.43	688 d
kg^{-1} soil	10	57 b	103 bc	32.0 b	12.2	9.66	796 c
	20	55 bc	131a	34.5 a	14.4	10.80	935 a
	30	54 c	114 b	33.1 ab	13.7	9.78	890 b
	40	50 d	100 cd	34.2 a	13.4	9.25	873b
NPK	0-0-0	53 b	85 b	27.3 b	10.1 b	7.89	656 b
	120-75-60	58 a	130 a	36.6 a	15.6 a	11.28	1017 a
Interaction							
NPK	PCC						
0-0-0	0	58 bc	71	18.8 f	7.8 g	7.07	504 g
0-0-0	10	54 de	82	27.2 e	9.2 f	7.89	596 f
0-0-0	20	52 f	99	30.1 cd	11.4 e	8.71	743 e
0-0-0	30	53 ef	92	28.7 de	11.2 e	8.16	731 e
0-0-0	40	49 g	83	31.6 bc	10.9 e	7.62	707 e
120-75-60	0	66 a	110	33.2 b	13.4 d	9.80	872 d
120-75-60	10	59 b	124	36.7 a	15.3 c	11.43	995 c
120-75-60	20	56 cd	162	38.8 a	17.3 a	12.90	1127 a
120-75-60	30	57 bc	135	37.5 a	16.1b	11.41	1049 b
120-75-60	40	52 f	117	36.7 a	16.0 b	10.88	1039 b
Significance							
PCC		**	**	**	**	**	**
NPK		**	**	**	**	**	**
NPK × PCC		*	NS	**	*	NS	*

Values sharing same letter(s) in each column do not differ at $p < 0.05$ according to LSD test, *Significant at $p < 0.05$, **Highly significant at $p < 0.01$, NS Non-significant at $p < 0.05$, 120-75-60 = NPK fertilizer rates as120 kg N ha^{-1}, 75 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}., PCC = Polyethylene coated calcium carbide.

application of PCC relative to control (Table 3). These changes might be due to consistent slowly release of acetylene from PCC that stimulated early root growth, improved N use efficiency and initiated new growth. Yaseen *et al*. (2005) has already reported improvement in vegetative growth due to nitrification inhibiting effect of calcium carbide. The increase in number of branches per plant might be due to classical effect of ethylene as ethylene induces horizontal growth by inhibiting auxin activity (Morgan and Dew, 1997). Calcium carbide based ethylene releasing matrix has minimized apical growth in okra (Kashif *et al*., 2012) and wheat (Ahmad *et al*., 2012). Calcium carbide dependent released ethylene counteracted the activity of auxin and resulted in less plant height and greater number of branches per plant (Mahmood *et al.*, 2009). The results showed that application of PCC at the rate of 20 mg performed better in the presence of soil applied NPK fertilizers.

Fruit Yield: A positive significant effect of accelerating rates of PCC on number of fruits and flowers per plant is presented in Table 3. Setting of more flowers per plant and ultimately more fruits per plant might be due to increase in branches per plant as well as more production of metabolites (Table 2). Consequently increase in fruit yield per plant is observed. Compared to NPK fertilizer alone treatment, each plant bore 10 to 17% more flowers on PCC treated plants due to nitrification inhibition and phytohormonal effects of PCC that resulted in 14 to 29% more onset of fruits. These changes led to higher fruit yield per plant than NPK fertilizers alone application. The increase in fruit yield followed quadratic trend. It increased up to 20 mg PCC kg^{-1} soil then declined with further increase in rate of application i.e. 30 and 40 mg PCC kg^{-1}soil. This effect might be due to higher concentration of ethylene than permissible limits released from exogenously applied higher rates of PCC that causes adverse effects i.e. inhibitory effect on plant growth and yield rather than stimulatory effect. Sudden decline in number of leaves, branches, fruits, flowers and fruit yield per plant in plants treated with higher rates support the explanation (Table 2) which were agreed completely by the findings of various research workers (Muromtsev *et al*., 1995, 1988; Kashif *et al*., 2012; Yaseen *et al*., 2012). Never the less it is obvious that improvement in the yield contributing parameters might be mainly due to improvement in N economy of soil as result of nitrification inhibitory effect of coated calcium carbide. The improvement in N economy in rhizoshpere led to more NUE (Yaseen *et al*., 2005; Mahmood *et al*., 2009) due to better performance of photosynthetic, physiological and biochemical processes.

Conclusion and recommendation: This study was conducted to evaluate the use of polyethylene coated calcium carbide for narrowing down the yield gap between cultivar potential yield and actual obtained yield. We found that PCC significantly affected photosynthesis, vegetative growth, plant dry matter, nutrient use efficiency and yield attributes in the presence of NPK fertilizers. Use of PCC could improve water and nitrogen use efficiency by releasing acetylene and ethylene in root zone. Among different rates, effect of 20 mg PCC kg^{-1} soil plus NPK fertilizers on yield attributes and fruit yield was found relatively better. Application of the best performed rate of PCC provides an innovation to multiply yield by maximum exploitation inputs resources. Use of coated calcium carbide as a nonconventional approach for high production of sweet pepper is likely a key issue to be resolved in order to make wide use of ethylene economically advantageous relative to traditional approach. Additional research on use of PCC for capsicum production in different environment and soil conditions is however will be required to fully exploit potential of this vegetable high fruit yield and nutrients use efficiency.

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