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IMPACT OF COCKLEBUR (*XANTHIUM INDICUM*) ALLELOCHEMICALS ON YIELD AND COMPONENT YIELDS OF GREEN GRAM (*PHASEOLUS RADIATUS* L.)

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ABSTRACT

Pot culture and field experiment were carried out to understand allelopathic effect of different concentrations of various types of dust of Xanthium indicum L. on the yield and component of yield parameters such as - (a) development of numbers of pods per plant, (b) number of seeds settled per pod, (c) weight of 1000 seeds and (d) seed yield per plant of green gram (Phaseolus radiatus). The experimental findings showed that different concentrations of various types of dust of test weed (5, 10, 15 and 20 %) in pot were influenced significant and caused inhibitory effect on the yield and component of yield parameters of the crop. In case of field experiment ratio of crop plant (C.P.) & Xanthium plant (X.P.) per plot (100:00, 75:25, 50:50 and 75:25) were exhibited negative correlation between increase of test weed population in experimental plot and the yield and component of yield parameters of the crop. The study indicates that the allelochemicals released from the various types of dust into the soil in pot culture experiment and increased weed density of the field were checked or altered the internal metabolic pathways or/and suppressed the regulation and function of phytohormones. Hence, the yield and component of yield parameters of green gram were reduced as per the dose intensity of dust of test weed in pot and density of weed population in the experimental field.

INTRODUCTION

Allelopathy is a universal biological phenomenon by which one organism releases bio-chemicals that effect the growth, development, reproduction and as a whole survival of the other organisms. The term "allelopathy" signifies the interactions between plants which might lead to either stimulation or inhibition of growth. Struggle for space and nutrients for propagation, continuity and survival is the most powerful law of the nature. Allelochemicals can alter the contents of plant growth regulators or induce imbalances in various intermediate molecules and phytohormones, which are inhibits the growth and development of plants. Different groups of plants like algae, lichens, crops and annuals and perennial weeds have wide known allelopathic interactions (Ahmad, *et al.,* 2004 and Uddin, *et al.,* 2007). Allelochemicals belong to different categories of secondary compounds such as phenols, benzoic and cinamic acids derivates, flavonoids, tannins, coumarines, terpenoids, alkaloids and poly-acetylenes (Duke, *et al.,* 2000). These chemical compounds with allelopathic activity are regulated by environmental factors such as water potential of the environment, temperature, soil moisture, light intensity, nutrients, soil microorganisms and perhaps other factors. They are distributed in varying concentrations in different organs of plants including leaves, stem and roots (Inderjit, 1996 and Chon, *et al.,* 2002). Day, *et al.,* (2003) reported that allelochemicals as non-nutritional chemicals produced by one organism which affect germination and growth, health and behavior/population biology of other crops. Allelochemical compounds inhibited plant growth by effecting physiological processes among them, the effect on ion transport across membrane and hydraulic conductivity are highly important since the root is the first plant structure to come into contact with allelochemicals in the rhizosphere (Blum, *et al.,* 1999). Rhizosphere allelochemicals, may be strongly affected the root tip as a result the rate of growth of crop plants are reduced. Chon, *et al.,* (2002) reported that some plant genotypes are likely to escape the allelochemical(s) by being "hypersensitive". The effects of these compounds are often observed to occur early in the life cycle causing inhibition and modification of plant growth and development (Ahmed, *et al.,* 2007). Shajie and Saffari (2007) reported that leaves and stems extracts of *Hordeum vulgare L.* significantly reduced germination and seedling growth in corn (*Zea mays L.*), canola (*Brassica napus L.*), sesame (*Sesamum indicum L.*), corn (*Zea mays L.*) weeds Lentil (*Lens culinaris Medic*) and chickpea

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(*Cicer arietinum L.*). These allelochemicals also affected corn seedlings either by decaying of hypocotyls or by producing of dwarf plants. Saffari and Torabi-Sirchi (2011) reported that wheat straw extract (variety of Falat) had a significant effect on reducing radicle length growth on corn 647 variety at concentration of 20, 40, 60, 80 and 100% . Tanveer, *et al.,* (2008) observed that mean germination time in maize (*Zea mays L.*), barley (*H. vulgare L.*), rice (*Oryza sativa L.*), wheat (*T. vulgare L.*) and sunflower was reduced by leaf leaches of *Hordeum vulgare L.* The increase in malondialdehyde synthesis is a common response of plants to allelochemicals, and this might be a subsequent response of plant to these chemicals beside cellular damage. Allelochemicals adversely affect malondialdehyde biosynthesis and accumulation by interfering in malondialdehyde biosynthesis and/or destruction. The upcoming negative effects of these processes would be retarding of photosynthesis and poor plant growth (Dash, *et al.,* 2013). Allelochemicals enter through the plant cell membrane and change the activity and function of certain enzymes (Li *et al.,* 2010). Whenever two or more plants occupy the same niche in nature they compete with each other for various life support requirements (Chon, *et al.,* 2005). Higher plants (tree crops) release some phytotoxins into soil which adversely affect the germination and yield of crops (Kaletha, *et al.,* 1996; Kumar, *et al.,* 2006).

Cocklebur, *Xanthium indicum L.* commonly known as Bur weed. It is found that this weed grows profusely in field of green gram crop during winter season. Green gram (*Phaseolus radiatus L.*) has an important rabi crop in the Indian agricultural economy. It has high protein content and serves as main protein supplement nutrient for rural people. Approximately 25-30 % agricultural crop fields are cultivated with green gram after harvesting of rice. *Xanthium indicum L.* is a predominant weed in agricultural fields of Odisha. There are several reports that allelochemicals from this plant negatively affect crops but there is very no information about the effects of *Xanthium indicum* allelochemicals on the yield and component of yield parameters such as - (a) development of numbers of pods per plant, (b) number of seeds settled per pod, (c) weight of 1000 seeds and (d) seed yield per plant. Basing on the above facts and views, the main objective of this study was to evaluate the effect of different concentration of various types of dust of *Xanthium indicum* by pot culture and field experiments on the yield and component of yield parameters of green gram (*Phaseolus radiatus L.*).

MATERIALS AND METHODS

In the morning hours Xanthium indicum plants collected at flowering and post flowering stage, from agricultural fields, were washed thoroughly with tap water followed by distilled water to remove the dust and other adhering particles from the surface of plants. Plant parts such as leaves, fruits were separated and allowed to dry-up in an incubator at 40 ± 2^{0}C. Different types of dust from leaves, fruits and whole plant body were prepared as per the methods described below.

Pot-culture experiment

These experiments were conducted in the open field (19^0 -80N and 84^0 -30E) in the Departmental garden of Aska Science College, Aska of Ganjam district. Earthen pots were of 25x 25 cm size containing equal quantity of well mixed sandy soil and cow-dung manure in a ratio of 8:1 parts (w/w) were taken. In order to have 5, 10, 15 and 20% concentration of whole-plant , leaves and fruits dusts separately in the soil of the pots, 5, 10, 15 and 20 grams of different dust were added per 100 grams of soil manure mixture in pots separately prior to sowing the seed. The visually selected and surface sterilized seeds of each test cultivar were directly sown @10 seed per pot. The pots were divided into 5 sets with 7 pots in each set. Out of 5 sets, one set was maintained without dust which served as control for individual crops. Care was taken to add equal volume of water in each pot periodically during the growth period of crops. After 10 days of germination the seedlings were thinned to stand 4 healthy seedlings per pot which were allowed to grow in pots till harvest.

Field study experiments

For field experiments, 3 plots measuring 200 sq. m. (20×10 cm) were chosen near Aska Science College campus (19^0 - 80N and 84^0 - 30E) Departmental garden, Aska. The plots were well ploughed twice after harvesting of rice crop and uniformly mixed with cow-dung manure. The surface sterilized seeds of green gram were sown uniformly in the board casting method in respective fields. Then each field was divided into 20 plots having an area of 10 sq. m. (2×5m) each. The crop plants and *Xanthium* weeds were allowed to grow in field under natural condition. Out of 20 plots of each field, 2 plots were ear-marked for control and rest 18 plots were ear-marked for 3 types of experiments. Fifteen days after sowing (DAS) in control plots (1-2), all the *Xanthium* weeds were weeded out and only 20 healthy crop plants were allowed to grow, in plot No. 3-8, the plants were thinned to 15 per plot and *Xanthium* weeds were allowed to grow 5 plants per plot, in plot No. 9-14, the crop plants were thinned to 10 per plot and *Xanthium* weeds were allowed to grow 10 plants per plot, in plot No. 15-20, the crop plant and *Xanthium* weed ratio was maintained in a ratio of 5:15 per plot for test crop. The plots were randomly designed basing on the population of test weed plants. All other plants were weeded out from the plots. In all slots of plants were allowed to grow in the field till harvest under natural conditions. Care was taken for prevention of pests.

Yield and parameters of yield

The methods for yield and parameters of yield such as (a) development of numbers of pods per plant, (b) number of seeds settled per pod, (c) weight of 1000 seeds and (d) seed yield per plant at the time of harvest are described below:

Number of pods per plant

At the time of harvest, the number of pods developed per plant were counted and noted. Then the matured and ripe pods were collected from plants of control and treated sets of both plants of the pot-culture and field experiments for counting the number of seeds settled per pod.

Number of seeds per pod

The developments of number of seeds per pod were counted and collected from each pod of individual plants of both control and treated sets of pot-cultured and field plants.

Weight of 1000 seeds

The seeds so collected from each plant of control and treated sets of pot-culture and field experiments were weighed for 1000 seeds and expressed in grams.

Seed-yield per plant

The seeds collected so far from individual matured and dried pods of both control and treated plants of both pot-cultured and field experiments plants were pooled together and weighted separately for each plant. The seed yield per plant was expressed in grams.

Statistical analysis

The data so collected were subjected to statistical analysis for calculation of standard Error of Mean (S.E.M.) and presented in tables.

RESULTS

Yield and component of yield of any crop plants are considered as an important parameter for production of crop. The yield efficiency of the concerned crops depends on the type of crop and its nature of soil profile and cultivation. In legumes, the yield /plant generally depends on various parameters such as (a) development of number of pods / plant, (b) setting of seeds per pod and (c) weight of 1000 seeds. The production of number of seed / plant is considered as the potentiality of crop-yield of the concerned plant. The results on yield and components of yield of test crop and influenced by shoot and root dust of rice stubble are described below:

The effect of various type and different concentrations of *Xanthuim indicum* dust on the components of yield and seeds yielded per plant of green gram are described below.

Development of number of pods /plant

From the Table -1 it can be observed that the development of number of pods / plant was considerably reduced by the influence of different concentrations of dust applied into soil of different pots. The maximum number of pods developed per plant in the plants of control set was 15.5 ± 0.1 whereas the values were reduced to 10.0 ± 0.08 and 11.2 ± 0.09 and 12.7 ± 0.11 respectively by the influence of 15% concentrations of whole-plant, leaves and fruits dust in soil of the pots. Other concentrations of the dust exhibited intermediate values. All concentrations of different types of dust considerably checked the production of pods / plant as a result of which negative correlations were established between production of numbers of pods per plant and increase in concentrations of dust in soil of pots.

In experimental field condition, the development of number of pods/plant was reduced from 22.7 ± 0.22 (control plot) to 15.2 ± 0.15 (plots with C.P and X.P. ratio of 25:75) in green gram plants. Intermediate values were noticed in plants of other plots having different ratios of C.P. and X.P. in the test plots. The production of number of pods/plant exhibited negative correlations with increase of test weed plant population in experimental plots.

Development of number of seeds/pod

The development of number of seeds /pod was considerably caused reduced by the influence of different concentration of various *Xanthuim indicum* dusts applied into soil of different pots. The maximum number of seeds developed per pod in the plants of control set was 12.5 ± 0.11 whereas the seed numbers per pod were reduced 5.7 ± 0.8, 7.2 ± 0.8, and 8.5 ± 0.15 by influence 25% concentrations of whole-plant, leaves and fruits dust in soil of the pots respectively. Other concentrations of the dust exhibited intermediate values (Table-1). All concentrations of different types of dust considerably checked the production of seeds / pod in the test crop plants as a result of which negative correlations were established between production of numbers of seeds per pod and increase in concentrations of all types of dusts.

In case of field condition, the production of number of seeds/pods in green gram plants reduced from 16.9 ± 0.19 (plant of control plot) to 10.7 ± 0.15 (plants of the plots with C.P and X.P. ratio of 25:75). Data of intermediate values were recorded for plants of other plots having different ratios of C.P. and X.P. in the test plots. The production of number of seeds/pods exhibited negative correlations with increase of test weed plant population in experimental plots.

Weight of 1000 seeds

The weight of seeds considered as an important parameter of yield because it is the indication of amount of metabolites stored in seeds during their development.

The weight of 1000 seeds, harvested from control plants, was 42.2 ± 0.23 g whereas the weights of same member of seeds collected from plants grown in pots provided with 15% test plant dusts were reduced to 28.4 ± 0.19, 30.4 ± 0.17 and 32.8 ± 0.17 g respectively. Plant grown in soils provided with other concentrations of both types of dusts exhibited intermediate weights between the above mentioned values (Table -1). The weight of 1000 green gram seeds exhibited a negative correlation with increase in concentrations of all types of dust applied into the soil of pots.

Plants of experimental field, showed the reduction of weight of 1000 seeds were from 43.2 ± 0.25 g (plant of control plot) to 22.3 ± 0.17 g in green gram plants grown in plots with C.P and X.P. ratio of 25:75. Intermediate values were noticed in plants of other plots having different ratios of C.P. and X.P. in the test plots. The weight of 1000 seeds exhibited negative correlations with increase of test weed plant population in experimental plots.

Seed yield /plant

Plants of control set yielded 16.54 ± 0.08 g of seeds /plant whereas plants influenced by 15% concentration of whole-plant, leaves and fruits dusts of *Xanthium* yielded 3.50 ± 0.04, 4.72 ±0.06 and 5.61 ±0.04 g respectively. Data of intermediate values were recorded for other plants influenced by different concentration of all types of dust (Table - 1). All the concentrations of dust considerably checked the yield efficiency of the test crop as a result of which negative correlation were established between seed yield / plant and increase concentrations of various types of dusts of *Xanthium indicum*.

Table 1 Effect of different concentrations of dust (whole-plant, leave and fruits) of *Xanthium indicum* plant on yield and components of yield of Green gram (Each value is mean of 5 replicates ± S.E.M.)

Types of Dust	Dust concentration (%)	Number of pods/plant	Number of seeds/pod	Weight of 1000 seeds (g)	Seed yield/Plant (g)
Control	-	15.5 ± 0.1	12.5 ± 0.11	42.2 ± 0.23	16.54 ± 0.08
Whole-plant	5	12.3 ± 0.11	9.2 ± 0.9	35.2 ± 0.19	12.44 ± 0.06
	10	11.7 ± 0.9	8.5 ± 0.9	30.2 ± 0.12	6.61 ± 0.07
	15	10.0 ± 0.8	5.7 ± 0.8	28.2 ± 0.19	3.50 ± 0.04
	20	*	*	*	*
Leaves	5	13.2 ± 0.11	10.7 ± 0.1	36.4 ± 0.19	13.52 ± 0.08
	10	12.2 ± 0.13	10.0 ± 0.9	34.1 ± 0.25	7.48 ± 0.07
	15	11.2 ± 0.9	7.2 ± 0.8	30.2 ± 0.17	4.72 ± 0.06
	20	*	*	*	*
Fruits	5	14.1 ± 0.11	1202 ± 0.13	38.6 ± 0.19	14.62 ± 0.06
	10	13.7 ± 0.12	11.5 ± 0.11	35.4 ± 0.23	8.24 ± 0.07
	15	12.7 ± 0.11	8.5 ± 0.15	32.8 ± 0.17	5.61 ± 0.04
	20	*	*	*	*

Table 2 Impact of crop plants and *Xanthium indicum* weed ratio on yield and components of yield of Green gram (Each value is mean of 5 replicates ± S.E.M.)

Ratio of crop plant (C.P.) & Xanthium plant per plot (C.P.: X.P.)	Number of pods/plant	Number of seeds/pod	Weight of 1000 seeds (g)	Seed yield/Plant (g)
100 : 00	22.7 ± 0.22	16.9 ± 0.19	43.2 ± 0.25	18.54 ± 0.08
75 : 25	19.8 ± 0.16	14.8 ± 0.17	40.1 ±0.17	15.34 ± 0.06
50 : 50	17.1 ± 0.17	13.2 ± 0.18	31.4 ± 0.19	9.61 ± 0.05
25 : 75	15.2 ± 0.15	10.7 ± 0.15	22.3 ± 0.17	4.19 ± 0.04

From the Table - 2, it can be noticed that the yield of seeds per plant was reduced from 18.54 ± 0.08 g (plant of control plot) to 4.19 ± 0.4 g plots with C.P and X.P. ratio of 25:75.in green gram plant. Data of intermediate values were recorded for plants of other plots having different ratios of C.P. and X.P. in the test plots. The seeds yield per plant exhibited negative correlations with increase of test weed plant population in experimental plots.

DISCUSSION

Agronomical point of view, the components of yield and productivity are of prime importance in study of plant productivity. During reproductive phase, the plants synthesize various metabolites as a result the metabolites are used for various physiological and biological functions and the rest are stored in plants at different part in different forms. In pulses, generally the components of yield comprise (a) production of number of pods / plants (b) no. of seed-setting / pod (c) weight of 1000 seeds and (d) total yield / plant. Rawson and Bremmer (1981) suggested that yield parameters control the yield-potentiality of principal temperate cereals like wheat, barley, pulses, etc. Evans and Rawson (1970) reported that yield of any crop is related to its photosynthetic activity and efficiency during seed/ grain filling whereas King, *et al.,* (1967) of opinion that production of assimilate are regulated by demands. Review of literature are available on yield performance in relation to plant growth on rice (Yoshida, 1972), Wheat (Evans, *et al.*, 1975) Barley (Gaseem, *et al.*, 1978), other temperature cereals (Wardlaw, 1974) and ragi (Acharya, 1994 and Pattanaik, 1998).

Regarding the influence of different concentrations of various types of dust of test weed on yield and its components of the green gram is discussed below.

Production of number of pods/plant

The production of number of pods depends on development of number of flowers per inflorescence, proper micro and mega-sporogenesis, fertilization, seed-setting and pod development. All these processes are influenced by both external environmental factor and internal genetic character. Further, the synthesis of various endogenous growth regulators responsible for flower inhibition and development are controlled by environmental factors such as solar radiation, nitrogen level, water supply, physico-chemical nature of the soil and etc. (Bishnoi and Krishnamurty, 1995).

It was observed that all concentrations of various types of dust of test weed considerably reduced the development of number of pods per plant in green gram cultivar. It suggested that the allelochemicals released from the dust into the soil might have checked the synthesis, translocation and/or accumulation of flowering harmones responsible for production of number of flower per inflorescence of the test plants. Further the translocation of nutrients and/or metabolites from source to sink might have arrested or inhibited by the phytotoxic compounds present in different concentrations of various dust in variable quantities as a result poor development of pods / plants were noticed in plants of pot culture experiment. In case of field experiment, the reduction in production of number of pods/plant might be due to root exudates or decomposition of weed litter that have released phytotoxic substances into the soil which later on directly or indirectly interfered on production of pods/plant. Padhy, *et al.,* (2006) reported that allelochemicals present in the aqueous leachate of leaf-liter of *Eulalyptus globulu*s, *Acacia nilotica* and *A. auriculaeformis* interfered on the growth and development of onion root through interfering in normal cell division processes. So, similarly the phytochemicals in the test weed might have checked the process of micro and mega-sporogenesis, mito-depression and cytological abnormalities during pod development. The present findings corroborate with finding of Sahu (2000) in green gram influenced by dipel-81 and multineem and Gantayat (2007) in pulses influenced by litter dust of *Eucalyptus globulus*.

Production of number of seeds / pods

After utilization of metabolites for general growth and development of any crop plants, the surplus metabolites in the leaves are translocated and stored in seeds of legume. The development of seeds and storage of various metabolities in seeds are controlled by various external environmental factors and internal physiological processes. In the present investigation, it was noted that the development of seeds to mature state in all test crop plants is drastically checked by different concentrations of various types of plants chemicals of dusts released into the soil of pot culture experiment, compared to their respective control plants which indicate that the translocation processes from source to sink might have checked by the phytotoxic chemicals present in the dust that have released into the soil and translocated into plants. Jackson and Compbell (1979) suggested that GA3 and cytokinin reduced the plant growth, dry matter accumulation and final crop yield in tomato. Murty and Prasad (1994) suggested that leaf area and their specific leaf weighs have significant correlation with photosynthetic rate per unit area of rice. Since the phytochemicals present in different dusts of test weed plants reduced the leaf area of the test crops, it is assumed that the phytotoxins might have reduced the photosynthetic efficiency as it was showed decreased trend in leaf area and L.A.I. resulting lower seed- setting per pod. Togari and Kashiokura (1958) and Wang and Yan, (1964) was opinioned seed/grain filling was more sensitive to environmental factors. Present finding corroborate the result of Gantayat (2007) in pulses influenced by leaf litter dust of *Eucalyptus globulus.*

In case of field experiment, similar trends in production or development of number of seeds per pod were noticed as in case of pot-culture experiment with application of various types of dust of test weed. The decrease of development of seeds per pod in green gram test cultivar in field condition might be due to release of phytotoxins released through root exudates and/or phytotoxic compounds released by decomposition of litter of the test weed.

Weight of 1000 seeds

From agronomical point of view, weight of 1000 seeds/grains yielded from plant (in pot-culture method) and Yield per hector (In field condition) are considered as one of the important yield parameters because those are the reflection of vegetative growth and source to sink relationship. Seed development generally depends upon amount of metabolites synthesized in leaves and their translocation to seed bearing structure and accumulated in the seeds. Higher accumulation of metabolites in seeds more is the weight of the seeds. In the present investigation, it was marked that in both type of experiments test weed considerably reduced the seed weight compared with their respective control plants. This suggests that the allelochemicals present in dust might have released into the soil and checked the source and sink relationship in pot-culture experiments and different types of phytotoxins released from root exudates and/or by litter decomposition in field condition. The phenolic compounds leached from the dusts as well as root exudation (in case of field condition) might have interfered in oxido-reduction reactions, nucleotide biosynthesis and other vital functions, controlling and/or preventing gibberellins' biosynthesis and accumulation of growth regulators in the cells causing inhibitory effect on vegetative growth and grain development during reproductive phase which ultimately might have reflected in seed weight. Rao and Reddy (1984) reported lower rate of yield of certain crops influenced by *Eucalyptus terrieticornis*. Muller and Chou, (1971) reported similar findings influenced by decaying of Eucalyptus litter. Reports on reduction of seed or grain weights were available on ground nut and corn (Jaykumar, *et al.*, 1990), wheat (Basu, *et al.*, 1987), ragi (Pattanaik, 1998). Sarmah (1992), Dalal, *et al.,* (1992) and Tripathy (2000) reported reduction in grain or seed number per plant and weights of 1000 grains or seeds in a number of crops influenced by various species of Acacia. Finding of Gantayat (2007) on reduction in seed weight influenced by different dust concentration of Eucalyptus leaves on pulses and pea corroborate the present findings. Hence, from the present investigation, it is concluded that the phytochemicals present in dusts and phytotoxins released from root exudates might have reduced or decreased the seed weight.

Seed yield per plant

The dry matter production of any crop plant is considered as important parameters of yield, it includes dry biomass of plant parts and yield. The latter is considered as the most important one since it has direct impact on its yield efficiency. Various environmental factors regulate different vegetative growth parameters and yield parameters which reflect on yield efficiency of concerned crop. In present investigation it was noticed that all the concentrations of different types of dust considerably reduced the yield efficiency of all the test crops compared with their respective control plants. This decrease in the yield per plant in both pot-culture and field experiments might be due to reduction in production of number of pods per plant, lower rate of seed setting which were controlled by reduction in vegetative growth parameters. As this type of work is first of its kind and available of literature in this line is scanty, in-depth research on various aspects i.e. physiological, biochemical, cytological, histo-enzymological and etc. are needed to draw any concrete conclusions. The work of Gantyat (2007) on impact of *Eucalyptus* on pulses and field pea corroborate with present findings.

CONCLUSION

The reproductive growth parameters such as - (a) production of numbers of pods per plant, (b) number of seeds settled per pod, (c) weight of 1000 seeds and (d) seed yield per plant of the test cultivar influenced by different concentration of dusts (whole-plant, leaves and fruits) of *Xanthium indicum L.* were exhibited a negative correlation with increased concentrations of dust. Similarly, higher the population of weed plant in the crop field, more was the adverse effect on green gram (*Phaseolus radiatus L.*). Therefore, it is suggested that *Xanthium indicum* weed should be weeded-out soon after appearance in the crop field before and/or after the sowing of crop seeds in the field. As different concentrations of dust and weed population were found to be responsible for poor establishment of yield parameters of the test crop, precaution should be taken to root-out the weeds in successive years before flowering for complete eradication of the weed from the field. Awareness should be created among the farmers regarding the harmful effect of *Xanthium indicum L.* on agriculture crops in general and pulses in particular.

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