

Effect of Contaminated Irrigation Water with Pesticide on Faba Bean (*Vicia faba* L.) Growth

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Abstract: The current study was conducted to study the physiological effect of pesticides on Faba bean plant (*Vicia faba* L.) growth using Chlorofete, (organophosphate insecticide). The plants were irrigated with contaminated water at different concentrations (0.1, 1, 5, 10 and 25 ppm) with the control sample and studied its effects on germination and vegetative parameters of the plant, length and diameter of stem, leaf area, the time of flowering and number of number of flowering, results showed that the pesticide has a large and clear impact on these parameters as it reduced the percentage of germination, length and diameter of stem and decrease the leaf area as well as speed up the flowering process and decrease number of flowers, leading to the end of the plant life cycle, 25 ppm concentration was more effective than the other concentrations and the lowest effect at the concentration of 0.1 ppm which relatively led to the natural growth to the control sample, which confirms that phosphorus pesticides have a significant impact on plant productivity and reduced harvested.

Keywords: chlorofetepesticide, Faba bean, growth

1. Introduction

The use of a wide range of chemicals to destroy pests and weeds is an important aspect of agricultural practice in both developed and developing countries. Although since ancient times there has been a major changes occurred as a result we get more elaborate molecule to tackle our agriculture produce safety, which has led to widespread concern over the potential adverse effects of these chemicals on human health (1).

Pesticides is a chemicals used to protect crop from pests such as Insects, Fungi, rodent there are two groups of Insecticides, organochlorine and organophosphate. chlorofete is an Anti-termite Insecticide which is A non-systemic organophosphate insecticide with contact, stomach and respiratory action, used to control insects that affect Potatoes, Carrot, Citrus and fruit trees. The problem and the risk of using pesticide in Agriculture and crop protection on environment are very high by accumulation of pesticide in soil plant, water, crop also on the non target plant lead to effected plant growth and biochemical structure of plant.

Pesticides cause regular or sporadic damage to established vegetation within the vicinity of agricultural lands. Non-target plant effects include a range of symptoms, including vegetative growth changes, plant death, altered reproductive capability that can generally result in reduced fitness, and detrimental economic or ecological impacts. Agricultural crops may be subjected to non-target effects by a variety of unintended exposure mechanisms, including accidents, local spray-drift from adjacent crop fields, aerial drift, surface water, groundwater, wind, and soil transport, and carryover in the soil from previous crops in crop rotation. (2).

Faba bean (*Vicia faba* L.) basic leguminous crops winter characterized by high contents of protein, making it is one of the green protein sources and thus they constitute an important part in the diet of people, especially poor pupils,

as well as its importance in improving the properties of soil fertility through nitrogen fixation process in soil (3).

Faba bean (*Vicia faba* L.) is a one of the most important legume in the Mediterranean region. It is cultivated for human consumption, cattle feeding and it is also used as green manure for the poor soils. This work shows the interest of the use of bean as biological and organic manure (4).

There are many studies about The effects of pesticides on seed germination, growth, survival, yield and residue quantification of crop plants (5; 6; 7; 8).

Due to the lack of studies on the effect of chlorofete used widely in the study area on the germination and growth characteristics of the plant, the aim of this research to study the side effect of Insecticide on growth properties of Faba bean (*Vicia faba* L.)

2. Materials and Methods

Experiment was conducted by planting the seeds of the plant bean during the growing season (spring), The Seeds of Faba bean were placed in Petri dishes (50 seed / Petri dish and moisten with chlorofete insecticide treatments TC 48% Chlorpyrifosin 0, 0.1, 1.5, 10 and 25 ppm the germination rate was documented after eight days.

For vegetative measurements, 10 seeds planted in metal pot filled with a mixture of soil and animal manure decomposed and by 2: 1 and sprayed with chlorofete insecticide an organic phosphorous pesticide produced by Jordanian Vabco company active ingredient is TC 48% Chlorpyrifosin 0, 0.1, 1.5, 10 and 25 ppm, with 3 replications for each concentration. Vegetative parameter were taken after 15, 25 and 40 days from the date of germination, plant height was determined by soil ruler, the stem diameter was

calculated by using a vernier caliper the average leaf area has been calculated depending on the way (9).

3. Result and Discussion

Although the use of existing pesticides, especially organophosphate pesticide and low concentrations of pesticides, is less harmful to the environment compared to those used in ancient times, there are still some effects of these pesticides on living organisms, especially plants as some of the negative effects on crop physiology such as visible injuries (chlorosis, leaf necrosis, vein discoloration, terminal bud death...) and growth reduction (10).

The higher concentrations of some pesticides particularly organophosphate insecticides, herbicides and systemic fungicides in soil, requires more time to degrade and there are reports to show that higher concentrations of pesticides have harmful effects on various growth parameters of plants. (11 ;12; 13 ; 14).

The intervention of pesticides to plants mainly through leaf surfaces, fruits, stem and roots (15). Pesticides can be spread

within plants as soon as they enter either from a cell to another cell or through the vascular system. The mechanism for taking and distributing the pesticide within the plant depends on the physical and chemical properties of the pesticide

A pesticide taken up alternatively or simultaneously by roots from the soil, two pathways to reach xylem vessels where it is moved to the top of the plant with the transpiration stream in the xylem: (1) the apoplastic pathway; (2) the symplastic route. (2) .

The presence of pesticide in soil lead to effects on plant ability to take the essential micro nutrients by an alteration of nitrogen and/or carbon metabolism leading to a lower nutrient availability and then exhibit negative effects on different growth parameters of nontargeted plant (10 ; 14) .

Pesticides also disturb the development of the reproductive organs, which may have affected significances on fruit and seed formation (10). Pesticide effects plant growth and productivity as shown in fig (1).



Figure 1: Effect of different concentration of chlorofete pesticide on faba bean plant compared with control plant

Time of seed germination

Germination time differed as a result of irrigation with the pesticide concentrations as described in fig (2), which show increase in time of plant germinate with the increase of concentration of pesticide. the less time of germination was in (0, 0.1 and 1) ppm concentration which was 6 days, more time of germination was in concentration 25 was 10 days.

Pesticides lead to delay the process of germination with increasing the concentrations of pesticides, it needs a longer period of germination, growth, and this adversely affects productivity.

Many authors have reported a lower rate of seed germination in soil contaminated by pesticide, (16) showed that Glyphosate has been stimulated plant growth in a range of species when applied at low doses on barley plants (17) found that the level of seed germination was decrease with increasing concentrations of chlorpyrifos in the soil and there is a significant reduction and delay in seed germination of *Lolium multiflorum* (ryegrass) was observed at the higher chlorpyrifos concentrations of 75 and 100 mg/kg.

(18) reported inhibition of germination of rice seeds exposed to three insecticides and two herbicides, commonly used in agriculture.. Triadimenole and triticonazole.

(19) reported that as the concentration of pesticide was increased in the soil, there was reduction and delay in seed germination of both the grass species *Cenchrus setigerus* and *Pennisetum pedicellatum* as monocropping and co-cropping system. They found a significant reduction and delay in seed germination of grass seeds at higher concentrations (75 and 100 mg/kg) of Chlorpyrifos compared to Cypermethrin and Fenvalerate.

Glyphosate, Treflan, cyrin, and Ridomil were reduced germination of *Faba bean (Vicia faba)* plants seeds significantly comparing with control in the study of (20).

In this study the germination time was more rapid in (0, 0.1 and 1) ppm concentration of pesticide than other concentration (Figure 2), and this is like the founding of the study of (21) which indicates that germination percentage of seeds, growth of the seedlings and biomass production were affected at different levels in *Vignasinesis* and *Oryza sativa*, at five concentrations investigated of DDT and Bordeaux. They find as the concentration of DDT and Bordeaux mixture increased, the rate of germination, decreased. which was 100% germination after 24 hours of treatment in the Control, 0.01% and 0.1% concentration of DDT, the treatment with 4% concentration of Bordeaux mixture, the lowest of 50% (*Oryza sativa*) and 40% (*Vignasinesis*) was recorded on the second day.

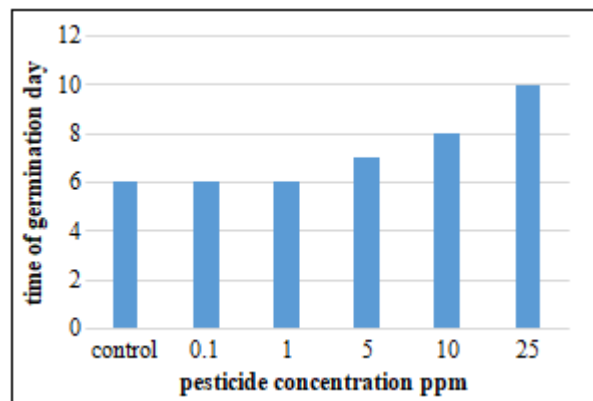


Figure 2: Effect of chlorofete on seed germination of Faba bean plant

Results of (22) study showed that the pesticides inhibited seed germination of soybean, as well as development of root nodules, the seeds in control soils had significantly higher germination rates than those in soils treated with pesticide. they found chlorpyrifos had the lowest seed germination, while Ridomil and the Combination were comparables; with the significant effect occurring from weeks 2 to 4. They detected that all pesticide types were nearly equally inhibitory to germination in the first week (very low germination rates in week one. And they found in the second – fourth weeks, chlorpyrifos retained the highest inhibitory effect (below 50%) on soybean seeds germination.

The results of (23) study indicated that chlorpyrifos was reduced the green gram (*vignaradiata* L.) seed germination percentage significantly when the increasing of concentration of insecticide. The data suggested that chlorpyrifos affect the seed germination and it was possible to evaluate the toxicity of insecticide in plant.

Pesticide induced stress in plants could cause the formation of phenolic compounds, such as the isoflavones - genistein and diadzein, phenolic acids and hydroxycinnamic acid derivatives which are all potential inhibitors of germination and plant growth (24; 25; 26; 27; 28; 29; 14) which Perhaps these phytochemicals were caused in response to chlorofete pesticide on Faba bean seed germination.

Effects of pesticide on Faba bean High and diameter:

After first germination of first concentration, we take the measure of plant high, the results show that inhibit the plant growth and reduce the plant height with increased concentration

Table (1) show that the maximum high of the plant was in the control sample (33.67 and 40.667 and 42.6) cm in the days (20, 30 and 45) respectively from the time of germination and appear to decrease with increased pesticide concentration. The most significant effect was on plant height at concentration 25 ppm, which was 22.67, 0.27 and 28.33 cm in the days 20, 30 and 45 from the time of germination respectively

The increase in length was low over time compared to the control sample, which indicates that pesticides affect the growth and productivity of plants and this is the result of the overlap with plant physiology

Table 1: Chlorofete effects on plant height in Faba bean overtime

	20 day after germination		30 day after germination		45 day after germination	
ppm	mean of plant high cm	SD±	mean of plant high cm	SD±	mean of plant high cm	Sd±
control	33.67	0.47	40.67	2.13	42.6	1.855
0.1	34.4	2.33	38.5	2.22	39.67	1.25
1	29.6	4.13	34.33	4.78	36	4.83
5	27.8	4.71	30.6	4.27	30.83	3.72
10	24.25	3.49	28.67	1.8	30.17	1.07
25	22.67	2.06	27	1.63	28.33	1.25

(30) reported that ethylene inhibited cell division of meristematic tissues and noticed that plants exposed to ethylene induced inhibition of stem height. Previous reports showed (31) that endosulfan at different concentrations (0.2, 0.4 and 0.6%) showed a significant decrease in percent germination, shoot length, in *Sorghum bicolor* (L.) Moench..

(6) found that Malathion and Pyrethroid effected *Helianthus annuus* plants from physiological aspect which is indicated by growth (plant height, stem diameter, Leaf area.

(20) found significant reductions in plant height of bean treated with Treflan and Glyphosate (3.375 and 17.012 cm respectively) when compared with control (42.950 cm).

(32) found plant height of faba bean may be decreased when treated with Glyphosate, and suggested that Glyphosate may increase the level of ethylene. Pesticides negatively affect plant growth and its effect observed on the diameter of stem and when the pesticides concentration increase It produces a plant with thin stem, It was less diameter of the plant stem at a concentration of 25 (ppm 2.847) mm, and highest diameter was in the control sample (4.513) mm. (table 2)

The presence of pesticide residues in the soil affects negatively on the uptake of water and the absorption of important nutrients in soil surrounding the plant through the effect on the plasma membrane of the root cells by inhibiting the process of taking cations including Zn, Cu and Mn etc, which reflects negatively in the abnormality in the different growth parameters (33 ; 14).

(34) observed that plant height and stem diameter decrease with the increase of glyphosate concentration on *Zea mays* L. and bean *Phaseolus vulgaris* L. plants and that at the highest dose of 1.0 g maize hardly grew at all whereas beans all had died by end of the experiment.

Table 2: Chlorofete effects on stem diameter in Faba bean overtime

	20 day after germination		30 day after germination	
Concentration ppm	mean of stem diameter mm	SD ±	mean of stem diameter mm	SD±
control	4.513	0.250	4.593	0.118
0.1	3.96	0.131	4.158	0.43
1	3.723	0.372	4.05	0.173
5	3.433	0.205	3.64	0.203
10	2.883	0.272	3.27	0.174
25	2.847	0.073	2.86	0.0572

(35; 23) Explain that the exposure of an organophosphorous insecticide, chlorpyrifos proved depressing for nitrogen metabolism and plant growth. The blocked growth might have resulted from the inhibition of normal cell division or elongation.

Chlorpyrifos and other Insecticides induced all the different types of damages to the cell division apparatus as genotoxic effects by effecting chromosome and mitotic stage which delay of growth and cytotoxicity and causes inhibition of certain cell cycle specific proteins which inhibit DNA polymerase and other enzymes, And thus lead to abnormal growth in the plant parts (36 ; 37 ;38 ; 39 ;40)

Leaf area

Leaf area plays an important role in plant growth by photosynthesis and this parameter is needed to compute disease severity percentage on plant leaf and the results used for actual prediction of yield loss and plant growth (41).

Fig (3) show decrease of leaf area with the increase pesticide concentration, the leaf area was in the high concentration of pesticide 25 ppm (7.16 mm) compared with the control sample (14.5 mm)

Because changes in leaf area partitioning or relative leaf area expansion rates can have an effect on relative growth rates that overshadow changes in net assimilation rates, and because net assimilation rates are largely a function of unit area rates of photosynthesis, the correlation of unit area rates of photosynthesis with growth should include consideration of leaf area partitioning or relative leaf area expansion rates. (42).

(14) indicate that pesticides, viz., Topsin M, Benlate (benomyl), Demacron (phosphomedon), and chlorosuphuron, Cypermethrin and Cypermethrindimethride (Lazer) can effects soybean plants growth by decrease leaf area and delay flowering

(43) found, that Insecticide abamectin (Avid), acephate (Orthene), bifenthiin (Taisrar), clarified hydrophobic extract of neem oil (Triact), and spinosad (Conserve) can effect on (*Gerbera jamesonhi* Bolus festival Salmon') by reduced leaf area (44) suggested that plants that have high unit leaf area rates of photosynthesis are likely to be strong competitors in cropping situations.

(45) showed Significant decrease under higher concentration of Dimethoate in leaf area, shoot and root length, fresh and dry mass of shoot, root and leaf whereas at lower concentration all the above said parameters enhanced significantly in *Vigna unguiculata* L. while (46) Significant decrease under higher concentration of Dimethoate in root and shoot length, leaf area, fresh and dry mass of shoot, root and leaf whereas at lower concentration, all the above said parameters enhanced significantly in *Momordica charantia* L.

(47) Root length, shoot length, biomass, number of leaves, flowers, pods, and leaf area increased at 0.1% concentration of Mancozeb and thereafter decreased in *Lens culinaris* L.

(20) found that there are phytotoxic effects of pesticides on different physiological processes such as distortion of leaves and growing points.

(34) showed that glyphosate was negatively affected leaf area of *Zea mays* L. and bean *Phaseolus vulgaris* L. plants at the highest concentration.

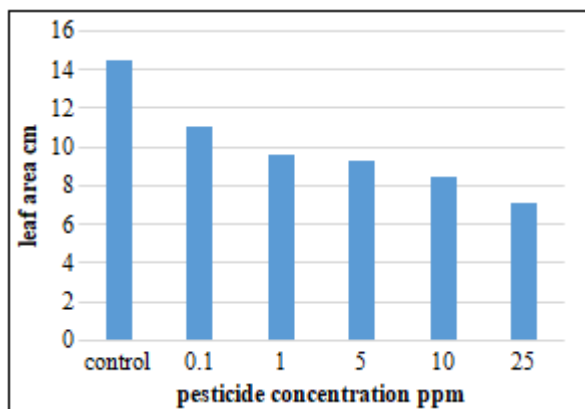


Figure 3: Effect of chlorofete pesticide on leaf area of Faba bean plant

Flower development

Time of inflorescence and number of flower

Flowering process are essential in plant sexual reproduction, so any changes this stage could effects on plants productivity. Time of flower and the number of flower effected by insecticide, the chlorofete pesticide effects on the productivity of faba bean plant by acceleration of the flowering, The time of the appearance of flowering differed depending on concentrations of pesticide, the flowering were much earlier at higher concentrations compared to concentrations and lower control treatment more the focus has led to stimulate the flowering process early and faster and then end of its life cycle without giving any fruits or pods are fruiting free from seeds. the time of flowering at Higher concentration 25 ppm was 38 days, while the time of flowering for lower concentrations and the control were more than it which allowed the fruit to mature with the time and the effect was more severe at high concentrations compared to the little concentration as in the following order form (Fig. 4): 25 < 10 < 5 < 1 < 0.1 < control sample

Pesticides Induced a significant effect on productivity In this experiment, the higher concentration of the pesticide have less productivity by reducing the number of flowers (Fig. 5), in the concentration of 25 ppm reduced productivity or the number of flowers to less than half 7 ± 1 compared to the control sample 19.67 ± 0.58

There are some of studies have indicated that reproductive structures such as flowers, pollen, and fruits or seeds are particularly sensitive to herbicide exposure, (48 ;49 ; 50 ; 51 ; 52) and effects of fungicide on flower production in different species (43)

(47) found that number of flower and pods decreased in *Lens culinaris* L at high concentration of Mancozeb pesticide. This is what (53) found, that Insecticide abamectin (Avid), acephate (Orthene), bifenthiin (Taisrar), clarified

hydrophobic extract of neem oil (Triact), and spinosad (Conserve can effect on (*Gerbera jamesonhi* Bolus festival Salmon') growth by reduced plant growth, development of flower and flower production, and increase number of flowering days. They instructed that These effects were likely due to reduced net photosynthesis and stomatal conductance, Reduced photosynthetic rates can impedes production times or reduce plant quality, in addition to any visible damage due to chemical toxicity, leading to economic loss (53)

(54) demonstrated that the high exposure to pesticide Furadan, ongermplasm, have a negative influence on reproductive indicators in greenhouse grown plants. When they found that Flowering duration of wild potato species was usually significantly reduced in comparison to a control.

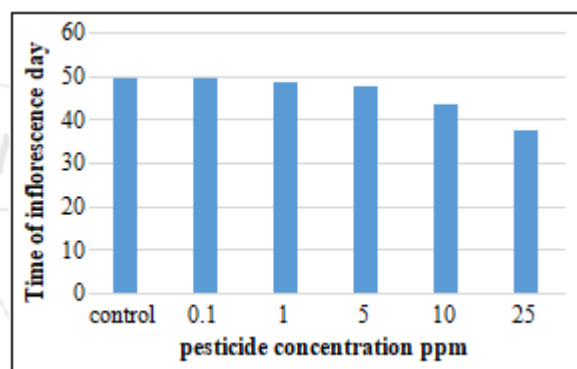


Figure 4: Effects of chlorofete pesticide on time of inflorescence of faba bean plant

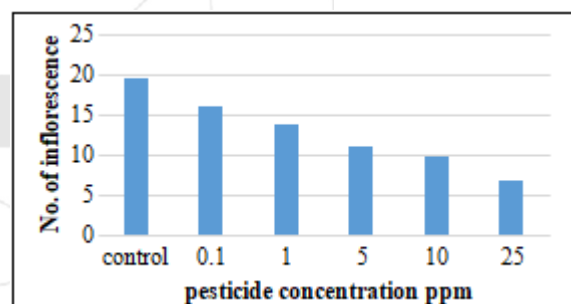


Figure 5: Effects of chlorofete pesticide on No. of inflorescence of faba bean plant

4. Conclusion

Chlorofete pesticide found to effected on the growth of faba bean plant in this study by effecting on seed germination, plant height, stem diameter, leaf area, Time of inflorescence and number of flower and the highest concentration was more effects on the growth of plant than the low concentration compared with the control plant.

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