International Standard Serial Number (ISSN): 2249-6807

International Journal of Institutional Pharmacy and Life Sciences 5(3): May-June 2015

INTERNATIONAL JOURNAL OF INSTITUTIONAL PHARMACY AND LIFE SCIENCES

Life Sciences **Research Article……!!!**

Received: 20-05-2015; Revised: 04-06-2015; Accepted: 05-06-2015

EFFECT OF INSECTICIDE APPLICATION ON THE POLLEN PRODUCTION AND POLLEN VIABILITY OF HYBRID TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

Reena S. Meshram* and Alka Chaturvedi

PG Department of Botany, RTM Nagpur University, Nagpur 440033, Maharashtra, India.

Keywords:

Pollen physiology,

Hybrid tomato,

Insecticide

For Correspondence:

Reena S. Meshram

PG Department of Botany,

RTM Nagpur University,

Nagpur 440033,

Maharashtra, India.

E-mail:

datta.dhale@yahoo.com

ABSTRACT

The present study examined the effect of insecticide Profex super (Profenofos 40% + Cypermethrin 4% E.C.) on the pollen production and pollen viability of tomato (*Lycopersicon esculentum* Mill.) under field conditions. Insecticide was applied to tomato plants in field at recommended dosage (30ml/15L water) and double the recommended dosage (60ml/15L). The data obtained revealed that the pollen production and pollen viability of tomato was lower in control and in double the recommended dosages as compared to the recommended dosages.

1. INTRODUCTION

"In seed plants, pollen grains embody the male partners in sexual reproduction" (K.R. Shivanna et al., 1993). Pollen biology has direct relevance in agriculture, horticulture, forestry, plant breeding and biotechnology. Pollen grains have potential use in gene transfer, monitoring cytotoxic effects of bioactive chemicals such as herbicides, pesticides and pollutants, etc. The list of potential uses of pollen is steadily growing.

Rapidly increasing world population in recent years brings about an increasing demand for food, which is one of the most serious problems for human, Ozturk Cali (2010). Various alternatives have been discussed in order to solve this problem. One of the methods is using resistant varieties and hybrid varieties. It is assumed that the use of chemical pesticides in agricultural areas increases the plant yield, Ozturk Cali (2008). In recent years, many chemicals are used as fertilizers, weedicides, fungicides, acaricide and insecticides which show adverse effect on soil and pollens. It is reported that fungicides could have negative effect on pollen germination, Pavlik and Jandurova, (2000). It was also reported that fungicides (Switch 62.5 WG (%37.5 Cyprodinil + %25 Fludioxonil) and Myths SC 300 (300 g/L Pyrimethanil)), decreased the fertile pollen percentage (N. Tort *et al*, 2005). Equation Pro 22.5% Famoxadone + 30% Cymoxanil, used as a fungicide increased number of abnormal stomata in tomato plants, Ozturk Cali (2008). When ACT-2, a vitamin K group activator was intensely applied to tomato then there is reduction in viability, shape of pollen and a morphological character has been changed, Ilkay Ozturk Cali and Feyza Candan (2010). Moreover a lot of insecticides have caused anomalies in mitotic and meiotic systems, N. Nicloff and A. Kappas, (1987) .On the other hand, Chlorothalonil fungicide impeded pollen germination of muskmelon and this situation could cause negative effect on fruit development (Abbott et al., 1991). Although many studies have been done to see the effect of fungicide on pollen morphology, pollen tube growth and pollen viability, very few researchers focused towards effect of insecticide on pollen production and pollen viability.

This study was thus conducted to determine whether insecticide Profex affects pollen production and pollen viability of tomato.

Profex is a mixture of compounds (Profenofos 40% + Cypermethrin 4% E.C.) IUPAC name of Profenofos is O-4-bromo-2-chlorophenyl O-ethyl S-propyl phosphorothioate. Chemical Abstracts name O-(4-bromo-2-chlorophenyl) O-ethyl S-propyl phosphorothioate. It acts as Cholinesterase inhibitor and Cypermethrin cyano-3-phenoxybenzyl (1RS,3RS;1RS,3SR)-3-(2,2dichlorovinyl)-2,2-dimethylcyclopropane carboxylate and Chemical Abstracts name cyano(3-phenoxyphenyl)methyl 3-(2,2, dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate. It acts on the nervous system of the insect, disturbs the function of neurons by interaction with the sodium channel. Mode of action Non-systemic insecticide with contact and stomach action. Also exhibits anti-feeding action. Good residual activity on treated plants. It is used on a control of a wide range of insects, especially Lepidoptera, but also Coleoptera, Diptera, Hemiptera, and other classes.

There is ample of information about how this insecticide affect the animal system, but less known about its impact on plant and pollen physiology.

2. MATERIALS AND METHODS

Healthy tomato (*Lycopersicon esculentum* Mill.) seedlings were grown from hybrid variety (Laxmi, manufactured by nunhems) of tomato. Selection of seeds was totally based on the demand of particular variety in market. Seeds were sown in seed bed and then planted in field. Profex super (Profenofos 40% + Cypermethrin 4% E.C., manufactured by Nagarjuna Agrichem Ltd.), the insecticide was applied on the seedlings of tomato in the field conditions. In total five applications were made at 10-days intervals, i.e. 30ml/15litre water as the recommended dosage and 60ml/15litre water as double the recommended dosage. A total of 6 groups, one control (untreated) and 5 treated groups for insecticide application were used during this study. The insecticide applications were prepared in 1 litre of water and applied at dosages recommended by the manufacturer and double the recommended dosage. Foliar applications were given by sprayer between 7:00 – 10:30 hours in the morning. The flower buds were obtained from research field of Botany Department of Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

Pollen production study was done by the method of Nair and Rastogy (1963), Mandal and Chanda (1981). Unopened flower buds were collected in the morning. One anther was crushed and dispersed uniformly in 5ml glycerine i.e.; 125 drops. One drop of dispersion was put on a slide and covered with cover glass and counted under compound microscope. Then average multiplied by 125 to get the number produced by one anther and finally to get the number produced per flower.

Pollen viability was done by the acetocarmine stain method suggested by (Qureshi *et al.*, 2009), with some modifications. Mature anthers were crushed and dispersed uniformly in 5ml acetocarmine (i.e. 125 drops). One drop of dispersion was put on a slide and covered with cover glass and counted under compound microscope. For each dose three slides were prepared. In each slide ten randomly selected fields were observed. Then average multiplied by 125 to get the number produced per anther and to get the viability produced per flower.

To determine pollen fertility, darkly stained pollen grains were recorded as fertile or viable and unstained or very lightly stained ones were considered as sterile or non-viable.

3. RESULTS AND DISCUSSION

Results of insecticide on pollen production and pollen viability of tomato were varied as shown in Table 1. In first two dosages of recommended dosage, the pollen production was found to be increased as compared to control but in further dosages it goes on decreasing. In case of double the recommended dosages, the pollen production was decreased than the control. An examination of the effects of the Profex used in the present study on pollen viability showed the percentage of viability increased in recommended dosages and double the recommended dosage as compared to control. But, pollen viability was found to be decreased in double the recommended dosage as compared to recommended dosage as shown in Table 2. Though it is used as an insecticide but now here it seems to act as a growth promoter when applied in recommended dosage but have negative effects when applied in doubled the recommended dosage. It was observed in some research work that the combined effect of two organophosphate insecticides and a dinitro herbicide resulted in a decrease in viability, about 60% in pollen of the *Solanum melongena*, P. Dubey, (1984).

Table 1 - Observation table for Pollen Production per flower of hybrid tomato plant:

Pollen production as per dosages					
Dosages→ Treatment↓	**Dose 1**	**Dose 2**	**Dose 3**	**Dose 4**	**Dose 5**
Control	47500				
Recommended Dose	53125	68500	29750	39500	26000
Double the Recommended Dose	37458	12125	41333	44000	38125

Table 2 - Observation table for Pollen Viability per flower of hybrid tomato plant:

Pollen viability as per dosages					
Dosages→ Treatment↓	**Dose 1**	**Dose 2**	**Dose 3**	**Dose 4**	**Dose 5**
Control	28.09%				
Recommended Dose	46.86%	**64.86%**	58.44%	47.23%	30.48%
Double the Recommended Dose	39.81%	36.34%	46.10%	**65.74%**	24.09%

Pollen production is an important aspect affected by insecticide, however there were negligible studies carried out on the effects of insecticides on the pollen production of tomato plant. Very few studies on the effects of pesticides on pollen morphology have been done. But in the present study pollen production shows variation and deformities were also observed regarding pollen shape, width and length in different dosage as compared to control. Similar results were found in *Lycopersicon esculentum* Mill. when ACT-2 a K-vitamin group activator was intensively applied, the percentage of oblate spheroidal pollen grains observed in the equatorial view decreased as the ACT-2 dosage increased while the percentage of prolate spheroidal pollen grains increased (Ozturk *et al.*, 2010).

The reduction in pollen production and pollen viability particularly in higher dosages was may be due to the biochemical changes or physiological or may be due to nutritional changes (minerals) in soil properties which impart pollen non-viability. In particular, the decrease observed in the percentage of viable pollen in the application group, particularly double the recommended dosages could have a negative effect on fruit productivity and quality of tomato in the future. Similarly, captan and many more chemicals decreased pollen viability in apple cultures (Church *et al.*, 1977).

Pollination is a complex and essential biological process for plant reproductive success. Over the years, plants made adaptations such as colour, morphology and smell to attract pollinators to ensure pollination, hence their reproductive success (Kasina *et al*,2004). These factors are ecological adaptations but in modern agricultural practices, different chemical pesticides are used and it is one of the important factors that affect the rate of visiting pollinators. Pollinators have been taken as indicators of a health ecosystem. Individuals and populations can be used to monitor environmental stress brought about by introduced competitors, natural enemies as well as by chemical and physical factors, particularly pesticides and habitat modification Kevan (1999). In the present study, after foliar spray of pesticide, the rate of visiting of pollinators was negligible for about one-two days, may be due to surrounding environment of plant or flower is changed. In *Lycopersicon esculentum,* self fertilization occurs but under favourable conditions. Still it needs pollinating agents for pollination because pollen is transferred from the stamen to the pistil when the flower is disturbed by wind, an insect or by some other means. There are many reports about the decline in pollinators. Other studies have found that pollinator limitation can reduce seed production by 50-60% in rare plants or plants in fragmented landscape (Jennersten,1988; Pavlik *et al*., 1933; Bond, 1995).

From the above discussion it can be concluded that pollinating agents are required. Pollen viability decreased with the increased in double the recommended dosage and there is no need of double the recommended dosage, only recommended dosages in multiples of four are required. It would help to reduce labour cost and economically beneficial to the farmers and help to restore environment. These results indicate that if the pollen production is although increased but if the pollen viability is decreased then it could cause a decrease in the productivity of fruits in the future. It may be due to biochemical changes affect the physiological aspects leading to less viability. So we should minimize use of chemical pesticides and do find new alternatives for chemical pesticides i.e. biopesticides.

REFERENCES

1. Abbott JD, Bruton BD, Patterson CL (1991). Fungicidal inhibition of pollen germination and germ-tube-elongation in muskmelon. HortScience 26: 529-530.
2. Bond WJ (1995). Assessing the risk of plant extinction due to pollinator and disperser failure. Pages 122-128 in J. G. Lawton and R. M. May, editors. Extinction rates. Oxford university press, oxford, United Kingdom.
3. Cali IO (2008). Effects of fungicide on meiosis of tomato (*Lycopersicon esculentum* Mill.) Bangladesh J. Bot 37(2): 121-125.
4. Cali IO, Candan F (2010). The effect of activator application on the anatomy, morphology, and viability of *Lycopersicon esculentum* Mill. pollen. Turk J. Biol 34: 281-286.
5. Church BM, Williams RR (1977). The toxicity to apple pollen of several fungicides as demonstrated by in vivo and in vitro techniques. J Hortic Sci 52: 429-436.
6. Dubey PS, Shrivastava A, Shevade A (1984). Pesticidal toxicity bioassay with pollen damage. Environ Pollut A 34: 293-295.

7. Jennersten O (1988). Pollination in *Dianthus deltoides* (Caryophylllaceae): effects of habitat fragmentation on visitation and seed set. Conservation Biology 2: 359-366.
8. Kasina M, Kipyab P, Wasilwa L, Gikungu M, Maina G, Odhiambo C, Gemmill-Herren B. (2004) Conservation and Management of Pollinators for Sustainable Agriculture, through an Ecosystem Approach, Addressing pesticide risks to wild pollinators in Kenya, First National Stakeholders Consultation Workshop, October 8-9, 2004, pp-802-806
9. Kevan PG (1999). Pollinators as bioindicators of the state of the environment: species, activity and diversity. Agriculture, Ecosystems & Environment 74 (1-3), 373-393.
10. Mandal S, Chanda S (1981). Aeroallergens of West Bengal in the context of environmental pollution and respiratory allergy. Biol. Mem 6: 1-61.
11. Nair PKK, Rastogi K (1963). Pollen production in some allergic plants. Current Science 32: 566-567.
12. Nicloff N, Kappas A (1987). Benomyl induced mitotic disturbances in Hordeum vulgare. Mutation Research 189: 271-275.
13. Pavlik BM, Ferguson N, Nelson M (1993). Assessing limitations on the growth of endangered plant populations. II Seed production and seed bank dynamics of *Erysimum capitatum* ssp. *angustatum* and *Oenothera deltoids* ssp. *howellii*. Biological Conservation 65: 267-278.
14. Pavlik M, Jandurova OM (2000). Fungicides cytotoxicity expressed in male gametophyte development in *Brassica campestris* after in vitro application of converted field doses. Environ. Exp. Bot 44: 49-58
15. Qureshi SJ, Khan MA, Arshad M, Rashid A, Ahmad M (2009). Pollen fertility (viability) status in Asteraceae species of Pakistan. Trakia journal of sciences, 7(1): 12-16.
16. Shivanna KR, Rangaswamy NS (1993). Pollen Biology- A laboratory manual, Narosa Publishing House, New Delhi.
17. Tort N, Ozturk I, Guvensen (2005). Effects of some fungicides on pollen morphology and anatomy of tomato (*Lycopersicon esculentum* Mill.). Pak. J. Bot 37(1): 23-30.
18. Yi W, Law SE, Wetzstein HY (2002). Fungicide sprays can injure the stigmatic surface during receptivity in almond flowers. Ann Bot 91: 1-7.

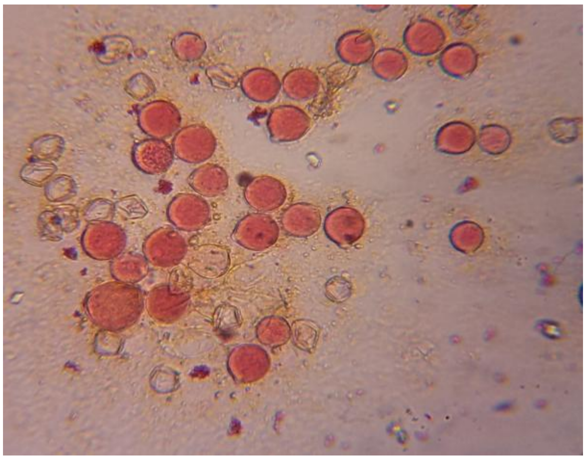

Figure 3: photograph showing Pollen viability in *Lycopersicon esculentum*

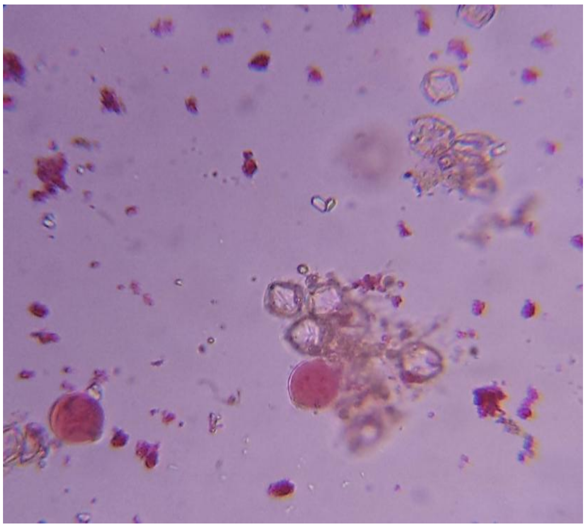

Figure 4: photograph showing Pollen deformities in different dosages of Insecticide in *Lycopersicon esculentum*

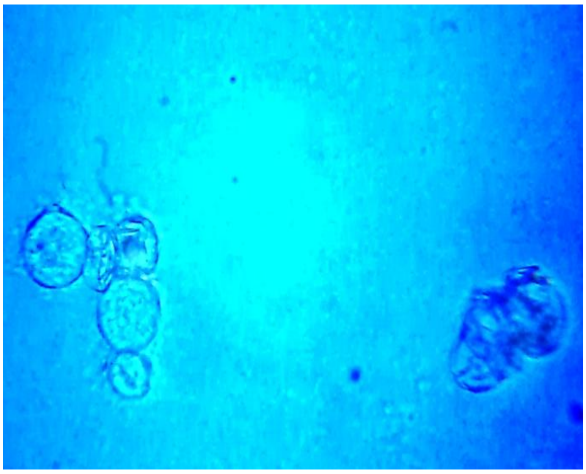

Figure 5: photograph showing Pollen production in different dosages of Insecticide in *Lycopersicon esculentum*