


Research Article

Genotoxic effects of profenophos on *Pisum sativum*

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Abstract

Profenophos is a commonly used organophosphate pesticide in pulse crops; however, it is difficult to say whether it is safe from cytogenotoxic effects. Test plant materials (field pea seeds) were soaked in 250 ml of 0.2%, 0.4% and 0.6% profenophos 50% EC separately for 6 hours. The mechanism behind various types of chromosomal anomalies observed due to treatment with profenophos has been discussed in detail. The effects of the pesticide that appeared in M₁ generation diluted in M₂. The appearance of C-metaphase with univalent and bivalents, multipolarities, chromatin bridges suggest that these organophosphate pesticides like profenophos affect genetic recombination which may lead to loss of important factors, gain of undesirable characters. This study aims at finding the cytological and genotoxic effect of pesticide profenophos on germ cells of *Pisum sativum* var. *arvense* and suggests judicious means of application of pesticides and agrochemicals in appropriate condition to elude further damages in the future.

Introduction

Pisum sativum (field pea) is one of the oldest domesticated and cultivated legume crops in the world. It is grown mostly in the tropical and temperate regions. In 2017, a total of 8,141,031 hectares of field pea were harvested globally, with the top producers consisting of Canada, Russia, China, India, and the United States (Food and Agriculture Organization, 2019). Field pea is an important source of plant protein (protein level 23-33%) for human as well as animals.

Among various leguminous crops grown in India field pea (*Pisum sativum* L. var. *arvense*) holds an important position as a pulse crop. In

India, it is grown mostly in the *rabi* (winter) season. It belongs to tribe- Viciaeae, order- Fabales, family- Leguminosae (Fabaceae), sub-family- Papilionaceae, genus- *Pisum* and species- *sativum* with chromosome number $2n = 14$ and has a plethora of utilities as food, feed and fodder.

Pesticides play an important role in modern intensive agriculture. They help to keep the pest population below the economic threshold level and thereafter increase crop yield (Ouyang et al., 2013). Although they are meant to be target-specific, their residual toxicity affects other non-target plant and animal species at cellular and molecular levels. Some of these

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Pest management in pulses and genotoxic effect of some pesticides in *Pisum sativum* var. *arvense*

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Abstract

Pulses are one of the most important crops grown in India. Every year pulses are attacked by various insect and non-insect pests either in field or at storage. Chemical pesticides are very effective in controlling pests due to their quick mode of action and residual toxicity, but these chemical agents have serious clastogenic and cytotoxic effects on the crop as well. A descriptive field survey was conducted in two pulse growing districts of West Bengal, India to figure out the commonly used pesticides for pulse crop cultivation in these regions. From them three such pesticides Profenophos, Spinosad, Dimethoate were selected and germinated seeds of field pea (*Pisum sativum* var. *arvense*) were treated with them. Mitotic preparation were made following the standard aceto-orcein technique and assessed. The study revealed that the use of these chemical pesticides can reduce Mitotic Index (MI) and induce genotoxic effects showing chromosomal abnormalities.

Keywords: Pulses, chemical pesticides, mitotic index, chromosomal aberration, genotoxic effect

1. Introduction

Pulses cater the protein requirement of the majority of Indian population and play a significant role in ensuring the nutritional security of the country. Because of their ability to fix atmospheric nitrogen in soil they used as green manure. Pulses also play a prominent role in agricultural system as cover crops in short season cropping windows, breakfast grains and dietary element. Pulses as a complement to cereals, make one of the best solution to protein-calorie malnutrition [1]. A variety of pulse crops including field pea, chick pea, mung bean, urad bean, lentil, french bean, horse gram, moth bean, grass pea are grown in different parts of the country. By 2030 and 2050 the pulse requirements of the country are estimated at 22.5-32.0 and 39.0 million tonnes, respectively. For this, an annual growth rate of over 2% is to be achieved [2]. Insect pest and diseases has always been a major threat causing significant losses in the yield. With the changes in climate and cropping systems, the pests have become more invasive and new pests having resistance to common pesticides have evolved. Some pests attack the crops more in the field during development while others attack in storage. Limited number of studies conducted, indicated yield loss in the field ranging from 15.6 to 67.8% for a pest complex and from 33.5 to 62.5% for specific pest species; meanwhile, losses in storage average 26.3% [3]. In modern agricultural system different types of pesticides are widely used to control the insect and non-insect pests that can remarkably reduce the amount of harvestable produce reducing the issue of crop losses to a great extent. Pesticide residues are known to persist in soil [4], water and in fruits and vegetables [5] and pose a serious threat for plant and human health. Genotoxicity and mutagenicity of pesticides on non-target organisms and their influence on ecosystem are of global concern [6]. Our investigations have been focused only to the usage of some chemical pesticides on pulses in West Bengal and their genotoxic effects in *Pisum sativum* var. *arvense* as pulse crop.

2. Materials and Methods

A descriptive survey was performed in Nadia and Murshidabad districts of West Bengal, India to find out the most devastating pests of pulse crops and the pesticides used to control them. Three pesticides Profenophos, Dimethoate and Spinosad were selected for study. The clastogenic and cytotoxic effects of the pesticides were analysed on the root meristem of *Pisum sativum* var. *arvense*. The growing root meristems of *Pisum sativum* var. *arvense* were immersed in Profenophos, Spinosad and Dimethoate solutions of 0.2%, 0.3% and 0.4% each. For each treatment, ten germinated seeds were transferred onto filter paper soaked in the pesticide solutions in petridishes and kept for 6hrs at room temperature. Distilled water was used as a negative control. After the mentioned period of exposure, three root tips from three seedlings per treatment were collected at random. Excised root tips were fixed in 1:3 acetic alcohol after that, mitotic preparation were made following the standard aceto-orcein squash technique and assessed. All the results were expressed as the mean of three replicates per sample \pm Standard Error (SE).

3. Results and Discussion

In West Bengal pest populations are dynamic, responding to climatic changes and misuse of protection practices. This led to the evolving new and often more damaging variants. Yield losses due to pests have been estimated at 10-35% annually. Pesticide consumption increased many folds with the introduction of high yielding varieties. The country manufactures all the conventional formulations including wettable powders (WP), Water Suspension Concentrate (WSC), Emulsifiable Concentrate (EC) or emulsion concentrate, soluble liquid (SL), dusts, aerosols. The pesticides are to be used only at recommended doses against a specific crop pest. Out of the survey conducted it was found that aphids, thrips, pod borers, pod bugs are the most devastating pests of pulses in West Bengal.

A Comparative Study on Economy of Some Vegetable Crops in Indian Market During the COVID-19 Pandemic

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Abstract:

The COVID -19 Pandemic is one of the greatest disasters of the century. It has affected a huge number of populations across the globe. Besides affecting people's health it has also agitated the world economy. The developing countries like India are facing a huge challenge to tackle the present economic turmoil. In this context the fluctuating prices of essential commodities like vegetables and fruits are catalyzing people's hardships. The study focuses on the trend in market prices of some vegetables in India in context of the COVID-19 crisis to find the reasons behind such trend and suggest some plans for their mitigation. Questionnaires were given to the APMC personnel, farmers, wholesalers and retailers either in plane paper or electronically as Google Forms pages. Market surveys were conducted wherever possible. Help of different print and electronic media, online meeting platforms were taken to collect relevant information. The findings revealed that the prices of vegetables dropped greatly in the early days of lockdown but in the latter half it surged up considerably. The reasons behind this were sudden drop in demand because of fear from pandemic outbreak and also because the mass consumers like restaurants, institutions remained shut after the declaration of country wise lockdown. Challenge such as the lack of cheap transport like the railways, closure of 'kisan-mandis', hoarding of commodities, restrictions on import and export, pressure from migrant labourers, disruptions of long supply chains etc. led to the sudden hike in market prices of vegetables. The paper recommended optimising supply chains, empowering smallholder farmers, promoting start-ups and MSME, resorting to digital platforms and understanding the changing consumer behaviour etc. to be some important actions towards a more resilient agri-food system.

Key Word: COVID-19; Pandemic; Agricultural economy; Market Price; Vegetables; Digitization; Transport facilities.

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I. Introduction

COVID-19, the greatest pandemic to date, has shaken up human civilization across the globe, taken millions of lives, making it utmost necessary for the nations to enforce total or partial lock-down and restrict international trade and transport, eventually pushing the global economy in the doldrums. The worst victim is the rural agrarian-sector, which is a significant contributor to India's economic growth. From inputs to sales, it magnified the vulnerabilities already present in our agro-ecosystem.

With about 5.4 million total cases that have a daily toll of nearly 92,605 people (20 September 2020), the government of India is at a crucial stage to regulate both COVID cases and economic activities side by side. Looking at the situation- it is almost impossible for the railways to start running local trains because it is the most susceptible one.

In states like Maharashtra, Delhi, Andhra Pradesh, Karnataka, Tamil Nadu, Uttar Pradesh, etc. the situation is far beyond control. In Maharashtra itself, around 1.9 million people have been affected (20.09.2020). The major industrial hubs having shut, the sole forerunner of India's economy during this lock-down is the agricultural sector. Yet due to the lack of cheap transport facility and several other reasons, it is not only the farmers who are facing losses, but the buyers are also passing through tough times as the market prices are shooting up. Especially the prices of vegetables have skyrocketed in states like Maharashtra, Delhi, and West Bengal.

II. Material And Methods

Study design: The study involved a descriptive survey research design.

Target population: The target population for the study were the buyers and sellers at different wholesale, retail markets and officials at Agricultural Produce Market Committees (APMC) across India.

Study Duration: March, 2020 to September, 2020
