

# Ground Application of Pesticides

T. SUZUKI

Director, Agricultural Chemicals Inspection Station

## Application of pesticides

The active ingredients of pesticides necessary to apply on crop plants are rather small in quantity. In order to have good pesticidal effects, however, they must be spray evenly, so as to be adhered to and absorbed in the plants. The increasing consumption of pesticide in Japan has joined progress in pesticidal applicator and applying technique. In the present paper, the term "ground application" is used against "aerial application", which has been popular lately in this country.

Pesticide is expected not only effective, but also easy to apply. Applicator and applying technique cover the some demerits of pesticide, giving better pesticidal effects.

## Factors in the ground application of pesticide

Application of pesticide depends on many factors, most of which are unchangeable. Then it must be planned and carried out under the given conditions. That is, soil condition of field, size of farm households, lay-out of farm road, farming labour, weather, pattern of cultivation and payable expenditure are determined prior to the pesticidal application in most cases. Recently, though land consolidation organizes fields, taking the pesticidal application into consideration, there are no means to control the weather conditions.

The active ingredients are formulated in emulsion concentrate, wettable powder, solution (they are generalized as spray liquid), pesticidal dust and granular. Pesticide are classified into insecticide, fungicide, herbicide and so on according to their use. As the application method varies with formulation, field type and pest object such as plant disease, insect pest and weed, the

most suitable one should be chosen, considering other environmental factors. Granular can be treated also with hand as the case of fertilizer.

Pesticidal applicators are roughly classified into duster, sprayer and granular applicator, which are the apparatus for pesticidal dust, spray liquid and granular, respectively. They range from small ones by man power to large ones by motor power. Furthermore, there are travelling types drawn by tractors. Even if applied kinds of pesticide and patterns of cultivation remain unchanged, the change in ability and scale of applicator results in the change in type of application.

Blow application and drift application are named after their ways of application. The latter has higher working efficiency, though with less effect than the former. Dust is blown onto the targeted plants when applied by the smaller type applicators, but only on the plants near the blow head when applied by the larger ones. But the blowing effect does not reach the plants growing apart from the applicators, and the spray particles must be accelerated by raising wind (speed sprayer) or induced by dusting hoses (power duster with boom nozzle type blow head), to keep the blowing effect. Essentially, the rate of deposit reduces with the increase of the working efficiency, and the balance between the rate and efficiency is an important factor which must be determined, meeting the demands of the times.

Many complicated factors affects the practical application of pesticide. They are the kind of pesticide, the concentration and quantity of spray liquid, particle size, timing (it refers to the stage of plant growth) and speed of application. They decide the necessary quantity of active ingredient, which is expected to adhere to the targeted plants

evenly.

A lot of basic investigation have been made on the adhesion of the necessary quantity of active ingredient to plants, instead of on the effects of the applied pesticides. Then it has been studied to measure the adhered quantity to the plants easily and rapidly by replacing pesticides with some material easy to measure. The results of these investigation give the valuable informations, suggesting how to improve the applying method, as it is easier to measure the adhesive quantity and examine the distribution of pesticide with chemical and physical methods than to evaluate biological activity in terms of controlling effects.

#### **The present situation of study of pesticidal application**

Among the pesticide applicators have power sprayers the longest history. But they had been tested to improve the working efficiency (power sprayer with blow type nozzle), since duster had been popular and mist sprayer used favourably in addition after the World War II. Meanwhile, many types of new ground applicators with high efficiency were developed, as the aerial application became popular.

The period between 1958—1962 is estimated to be offered to the study and test to raise up the efficiency in pesticidal application. The contents of the study and test amounting to more than a hundred are summarized as follows. Most of them are concerned with application methods.

The major part of studies on applicators concerned speed sprayers and power sprayers with swath nozzle. The formers were introduced into the fields, while the latter into the paddy fields as large type applicator for spray liquid. The next most were on the improvement of mist sprayers and power sprayers. Some fundamental studies were also made on nozzles.

The pesticides tested most frequently were organophosphorus insecticides, followed by organomercuric fungicides and pesticides for apple trees. Lime, ammonium

sulphate and dye stuffs dissolved in water were substituted for pesticides. Bordeaux mixture is very convenient to get basic data on the application method as copper in the mixture is easy to analyze quantitatively. Antibiotics, pesticides for deciduous trees were also used.

Rice plant ranked first among the test plants, followed by apple tree, deciduous fruit trees and citrus trees in this order. Vegetable crops were also tested in a considerable degree. Studies were also made on the distribution of pesticide on the fields without standing plants and on the adhesion to the model trees with leaves. Fruit trees are generally more difficult than rice plant to set experimental plots and examine the experimental results.

As is seen from the kind of the tested pesticides, rice stem borer and rice blast were tested most frequently as pest insect and disease, followed by pests on apple tree, leafhoppers and planthoppers. Many studies were also made, neglecting the effects on pest objects consciously.

Most of the above-mentioned studies and tests concerned the problems on trial applicators from the both fundamental and applied points of view. Applied test must be carried out in the open field, and may pollute there with pesticide or substituted substance. Therefore, it is not permitted to administer in city part or its outskirts and takes a lot of time and money to carry out without public hazard. Furthermore, the weather factors must be recorded in the report as they are very important and discussion must be made on spraying efficiency. It is not reasonable to calculate the working efficiency per day arithmetically, having grounds on the result of only one spraying test.

The ground application of dust is not so frequently tested. Dusting tests were mainly made by helicopter. Anyhow, main application methods of pesticide can be classified as follows: 1). high volume spray of spray liquid, 2). low volume spray of spray liquid and 3). dusting. High volume spray is made by power sprayer and power sprayer with swath nozzle, while low volume spray

by mist sprayer. The latter has been influenced by aerial spray of ultra low volume pesticide. Pesticidal dust can cover plant efficiently for its weight with almost same volume as in low volume spray of liquid. In addition, dust can be distributed further and wider because it has a rather small apparent density for its particle size. This fact explains the higher efficiency in dusting. It is a peculiar character to this country where sloping area is cultivated for use and the highly intensive agriculture is prevailing, that dusting is preferred in spite of its higher cost than liquid spray. Recently, trials have been made to apply dusting to citrus orchard.

Pesticidal effect depends upon not only pesticide and apparatus, but also technique to use them. The easier the technique is, the better and more popular the method becomes. Speed sprayer is rather difficult to conduct, but easy to have right spraying, while small type apparatus is easy to handle, but difficult to spray pesticide evenly. Generally speaking, pesticide is often sprayed in less than necessary quantity when small type apparatus used.

Pesticidal effect is always displayed through the sprayed particles of pesticide. More than one factor determine what most suitable particle is. Main character of spraying depend upon the size, density and velocity of the particles. Technique of making good particles is conditioned with both pesticide and apparatus.

In the present time, the spraying apparatus will be estimated as of no practical use, if it cannot be conducted outside of

the paddy fields. As a result, handy method of dusting, such as that by the pipe duster, where the hose with small holes is drawn by the men walking along the both sides of paddy field, has become very popular. On the other hand, drastic improvement in the lay-out of farm is now required to introduce highly efficient apparatus. For example, a trial is now under way in the citrus zone in Shikoku Island, to raise up productivity, rationalizing pest control by turning 20% of cultivated land into farm roads.

#### Future of ground application of pesticide

Whether it is the above-mentioned ground application or aerial one, pesticidal application should be practiced with the right method in the right field. Ground application is not necessarily satisfying method, when the present shortage of farm labor is considered. Farmers will be exhausted, if they continue applying pesticide for a long time, tightly dressed in the broiling weather. Therefore, the easier method of pesticidal application is always expected eagerly. Dipping test of plant root is repeated for the development of systemic pesticides, which can be treated on or in soil instead of being sprayed or dusted. Development of attractant is also expected.

With the progress of pesticide, it has not become necessary to spray Bordeaux mixture on the both side of plant leaves. The easier and more efficient application of pesticide should be developed with the help of the improvement of both pesticide and applicator.

## New Crop Varieties Bred by Mutation Breeding

T. KAWAI

Chief, 3rd Laboratory of Genetics, Division of Genetics, Department of  
Physiology and Genetics, National Institute of Agricultural Sciences

#### Background

Induced mutations of practical significance in Japan were first reported on rice by Ichi-

jima in 1934. Mutation studies, bearing utilization of induced mutations for plant breeding in mind, were started after the