SINGLE GRAIN/SINGLE INSECT ASSAYS FOR INVESTIGATING EVENNESS OF INSECTICIDE APPLICATION TO AUSTRALIAN WHEAT

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ABSTRACT

A method of laboratory evaluation of evenness of field application of grain protectant insecticides to wheat is outlined. The need to examine spread of insecticide to individual wheat grains arose in design of an applicator to control and monitor wiping of concentrated grain protectants onto wheat.

Spreading of concentrated insecticide wiped onto wheat was compared with spreading of diluted insecticide sprayed onto wheat in both 4 tonne lots in farm silo bins and 750 tonne bulk handler's silo bin treatments.

At the target application rate of 1:8:12 mg/kg bioresmethrin:piperonyl butoxide:fenitrothion, using young adult Sitophilus oryzae as test insects, 32 ml concentrate appeared to be as well distributed on one tonne of wheat as 1000 ml water-diluted concentrate when treated wheat was examined 0, 1.5, 3, 4.5, 6 and 9 months after treatment.

INTRODUCTION

One of the questions presented when discussing the technique of wiping insecticide concentrate onto wheat, instead of spraying the same formulation diluted with water, was how thoroughly could 32 ml concentrate be distributed on 1000 kg wheat?

Single grain chemical assays needed method development time but the entomological approach was expedient. However, operator dexterity was a pre-requisite.

In preliminary tests with an early version of the concentrated insecticide wiper a blue food dye was added to the insecticide prior to application to wheat. By carefully examining many grains and assessing the percentage of grains marked blue, compared with the total number examined, we were discouraged when only 81% grain appeared to have picked up detectable insecticide.

It was difficult to examine each grain thoroughly without removing the microscopic blue spots with even the finest of forceps. Single grain chemical assays would solve the problem but to develop and validate the method and cope with runs of 1000 individual grain assays would have taken much time and we were anxious to have a quicker answer. From an entomological point of view the solution was obvious.

MATERIALS AND METHOD

The Wellcome Grain Pesticide Applicator was programmed to apply 32 ml concentrated insecticide comprising 20 ml BRM 5/50 (bioresmethrin/piperonyl butoxide) and 12 ml Fenitrogard (fenitrothion) per tonne of grain, both in farm and bulk handler's silo treatments.

The Cooper Grain Sprayer in farm treatment and their own manufactured grain sprayer in NSW Grain Handling Authority's storage were adjusted to apply 1000 ml water-diluted insecticide comprising 20 ml BRM 5/50, 12 ml Fenitrogard and 968 ml water on each tonne of wheat.

The approximate tonnages treated were 4 tonnes in flat steel welded farm silos on the Wellcome Research Station "Bangalla" for each method of application, and 750 tonnes in steel-reinforced concrete silos belonging to NSW Grain Handling Authority at Holmwood.

Treatment points were in the chute leading into an auger for the farm application and on a conveyor belt in the bulk handler's storages.

Target application rates of insecticides were 1:8:12 mg/kg bioresmethrin, piperonyl butoxide and fenitrothion, respectively.

Single grain single insect bioassay used Durham or fermentation tubes 25mm long x 3.5 mm internal diameter x 6 mm external diameter which stand virtually upright in Cooke microliter or Kayline U-plate trays with 96 wells.

From composite bin samples single whole grains (96) were selected at random and placed, one to each tube. The internal surface of each tube had a dried fluon skid zone to prevent Sitophilus oryzae adults of 1 to 2 weeks of age escaping. Assays were maintained at 25°C, 55% RH for three weeks, after which insect mortality was assessed. Mortality readings were made with grain samples taken after 0, 1.5, 3, 4.5, 6 and 9 months post-treatment.

Comparison bioassays were made using the standard assay procedure (Nicholls 1990).

RESULTS

With farm treatments both wiper and sprayer treated grain produced 100% mortality of Sitophilus oryzae adults at each interval tested up to and including the 6 months post-treatment assay. 100% mortality continued to 9 months for the wiper treatment when the spray treatment produced 93% mortality using the single grain/single insect assay method. Untreated control wheat produced 1% mortality at time zero and 0% mortality at each subsequent assaying (Table 1).

Either 99% or 100% mortality of Sitophilus oryzae adults occurred in Holmwood concrete silos at all the time intervals tested (Table 1).

Using the standard laboratory bioassay method (Table II) the wiper and sprayer treatments were indistinguishable as both produced 100% adult mortality at each sampling interval.

DISCUSSION

The single grain single insect technique was devised to investigate scepticism concerning the thoroughness of insecticide coverage on individual wheat grains. All grains selected for assay carried enough insecticide to cause mortality of Sitophilus oryzae following diluted spray application or when the volume of liquid applied was reduced to 32 ml concentrated insecticide. The insecticide distribution was sufficient to cause mortality of these insects on the grain selected for testing from the composite silo samples.

In the "Bangalla" situation treated grain was transported by two augers before spilling into the silo through the roof hatch, whereas at Holmwood grain fell from the conveyor belt into the elevator boot from whence it was picked up by the elevator buckets prior to passing through a chute and falling into an open topped bin. In both situations there was apparently enough mixing to thoroughly distribute the insecticide around the grains.

CONCLUSION

The wiper applied insecticide was found to be as evenly distributed throughout the grains of wheat as the widely accepted sprayer applied insecticide, each method having the target application rate of 1:8:12 mg/kg bioresmethrin:piperonyl butoxide:fenitrothion.

REFERENCE

Nicholls A.W. (1990). Proceedings of the 5th Working Conference on Stored Product Protection "Bioassay validation of an applicator developed to precisely control the wiping of concentrated insecticide onto a moving grain stream".

Table I: Efficacy of target applications of 1:8:12 mg/kg bioresmethrin: piperonyl butoxide:fenitrothion to wheat, silos stored in two locations, assessed by laboratory single grain single insect assays in 1987

Location	Method of insecticide application	Percentage mortality of Sitophilus oryzae at following time intervals (months post-treatment)					
		0	1.5	3	4.5	6	9
"Bangalla"	Wiper	100	100	100	100	100	100
	Sprayer	100	100	100	100	100	93
	Untreated	1	0	0	0	0	0
Holmwood	Wiper	-	100	99	100	100	99
	Sprayer	-	100	100	99	100	100

KEY:

- no assays made prior to method being devised.

Table II: Efficacy of target applications of 1:8:12 mg/kg bioresmethrin: piperonyl butoxide:fenitrothion to wheat, silo stored in two locations, assessed by standard laboratory bioassays using 110 young adult insects on composite silo samples of 150g wheat in 1987

Location	Method of insecticide application	Percentage mortality of Sitophilus oryzae at following time intervals (months post-treatment)					
		0	1.5	3	4.5	6	9
"Bangalla"	Wiper	100	100	100	100	100	100
	Sprayer	100	100	100	100	100	100
	Untreated	1	0	0	0	0	0
Holmwood	Wiper	100	100	100	100	100	100
	Sprayer	100	100	100	100	100	100

LES MESURES FAITES PAR LA METHODE "UN SEUL GRAIN/UN SEUL INSECTE" POUR ETUDIER L'UNIFORMITE DE L'APPLICATION DES INSECTICIDES SUR LE BLE AUSTRALIEN.

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Résumé

Nous décrivons dans ses grandes lignes une méthode de laboratoire servant à mesurer l'uniformité d'application des insecticides de protection des semences sur le blé. Le besoin d'étudier la répartition des insecticides sur un seul grain de blé est venu de la nécessité de concevoir un appareil de contrôle de l'impact des produits sur le grain.

L'application d'un insecticide concentré sur le blé a été étudiée en nébulisant un aérosol d'insecticide sur des lots de 4 tonnes, choisis dans les cellules d'un silo et de 750 tonnes de vrac dans un silo équipé pour ce genre de traitement.

En appliquant une combinaison de doses optimale de 1:8:12 $mgkg^{-1}$de bioresméthrine : pipéronyl butoxyde : Fenitrothion, et en utilisant de jeunes adultes de *Sitophilus oryzae* comme témoins, il s'est avéré que 32 ml de concentré était aussi bien répartis sur une tonne de blé que 1.000 ml de concentré dilué dans l'eau, à l'examen du blé, 0 ; 1,5 ; 3 ; 4,5 ; 6 et 9 mois après le traitement.