

Survey of Wheat Growers Using Restricted Fungicides, Propiconazole and Triadimefon, Ontario, Canada, 1987

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Bayleton[®] and Tilt[®] are the respective trade names for the two fungicides triadimefon and propiconazole discussed in this paper. Both are broad-spectrum systemic fungicides with activity against foliar stem diseases on cereal crops (Buttler, 1983; Anonymous 1987 a, b). Both inhibit the sterol, ergosterol, in sensitive fungal diseases attacking cereals (Anonymous 1987, a,b). During 1987 both were given temporary Canadian registration but restricted to use on wheat (Anonymous 1987 c). As a consequence in Ontario both fungicides were restricted to permit use. The reason for these restrictions was based on the fact that gaps existed in the toxicology package making it impossible to calculate a use pattern with an adequate margin of safety (Anonymous, 1987c). The reason for allowing use in the absence of adequate risk assessment first place was based on a recommendation from the Ontario Ministry of Agriculture and Food (OMAF) that indicated a critical need existed for disease control in the production of hard red winter wheat under intensive cereal management (ICM), now being practised by many producers.

A post-application survey of permit holders was conducted to monitor whether growers' were abiding with federal and provincial requirements prescribed on safety precautions and procedures and rates of application. Soil and crop samples were analysed for residues to determine if the correct period between application and harvest were observed.

MATERIALS AND METHODS

During 1987, 736 cereal farmers obtained permits to purchase and apply triadimefon to winter wheat or propiconazole to winter and spring wheat for the control of several foliar and stem diseases. Triadimefon was sold under the trade name of Bayleton[®] and made available for one application to be made up to 60 days before harvesting hard red winter wheat. Propiconazole was sold under the trade name of Tilt[®] and was available for up to two applications made not later than to 45 days before harvest to hard red winter wheat or soft white spring wheat. A survey was conducted on 103 (14%) growers, randomly selected from the 736 permit holders growing both types of wheat.

The randomly selected permit holders, located in five districts of three regions, were interviewed by Ontario Ministry of Environment staff. The five districts included in the survey represented 94.5% of all Bayleton[®] permits and 73% of -

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all Tilt^R permits issued. The 103 growers held 41 Bayleton^R and 81 Tilt^R permits. Permit holders who had and had not used Bayleton^R and/or Tilt^R were interviewed for the survey. Those who did not purchase and use either fungicide were not asked any questions dealing with the purchase or application of the fungicides.

During the survey farmers were asked about the following items dealing with the application.

1. Statistics on the wheat planted, the areas sprayed with the two fungicides and whether they were practising intense cereal management.
2. Enquiries into who was the applicator, what protective clothing was worn, whether they were aware of the label and permit restrictions and what rates were used.
3. Enquiry into whether re-entry periods and pre-harvest intervals were observed.

Soil samples were obtained using a rinsed and dried garden shovel from growers field immediately prior or immediately post harvesting the crop. Surface soil (top 5 cm) was collected from 5 places between the rows of the cereal crop and a composite sample was taken for analysis. Straw samples were collected at the same time as soil samples. Approximately 200 g of straw (6 plants) were randomly collected at each of 5 sites in each field. Soil and wheat samples were stored in an ice cooler for delivery to the Ontario Ministry of Agriculture and Food Pesticide Laboratory for analysis.

Soil and straw samples were extracted and partitioned with slight modification to the procedure described by Buttler (1983) and Bai and Lui (1985). Acetonitrile was used in place of methanol and 1 ml of 50% H₂SO₄ was added to improve the extraction. Identification and quantitation were carried out by gas liquid chromatograph similar to that described by Buttler (1983) and Bai and Liu (1985) using a nitrogen-phosphorus detector.

RESULTS AND DISCUSSION

The total area of wheat, planted by the 103 growers in the survey, was 5140 ha (Table 1) including both soft white and hard red cultivars. The hard red cultivars were all winter wheat strains and accounted for 78% of the total wheat planted. The soft white wheat was all spring planted. Triadimefon was registered for hard red winter wheat only, while propiconazole was registered for both. Thus, some growers used both chemicals (Table 2). Of the 5140 ha of wheat on the surveyed farms, 4168 ha (or 81%) had a disease incidence that warranted treatment with either triadimefon or propiconazole; 3096 ha (or 60%) received the latter and 1072 ha (or 21%) received the former fungicide. Thirty three (32%) of the growers obtained permits but did not have a high enough disease incidence to warrant spraying.

Both fungicides carried labels that specified that the use was primarily for those growers participating in an Intensive Cereal Management (ICM) program. This

was reinforced by the permit which was issued specifically for those in the ICM program. At least 25% of the 103 growers surveyed received but did not qualify for a permit. However only 69 growers actually used the permit and 61 were involved in the ICM program. Sixty eight of the 69 growers were aware of the restrictions of the fungicides.

Under the permit, only the permit holders or custom spray applicators were the people allowed to actually apply these restricted fungicides. Forty seven of the 69 permit holders applied the fungicides themselves, while 12 permit holders hired custom applicators (Table 3). Nine of the 69 permit holders allowed application by persons not covered under the permit.

Table 1. Area of wheat planted and treated with fungicide among 103 growers surveyed with a questionnaire.

Item	Hard Red Winter Wheat ha (%)		Soft White Winter Wheat ha (%)		Total
Planted	2903	(56)	2237	(46)	5140
Propiconazole alone	430	(18)	1683	(33)	2613 (52)
Triadimefon alone	589	(11)	NA		589 (11)
Both fungicides	483	(9)	NA		483 (9)
Not treated	901	(18)	554	(11)	1455 (29)

Table 2. Numbers of the 103 growers growing and treating hard red winter and soft white spring wheat with fungicides.

Number of wheat growers				
Winter Wheat	Summer Wheat	Winter and Spring Wheat		Total
8 (N) ¹	11 (N)	15 (N/N) ²	5 (N/P)	39
5 (T)	0	13 (T/P)	2 (T/N)	20
8 (P)	10 (P)	10 (P/P)	3 (P/N)	31
10 (PT)	0	1 (PT/P)	2 (PT/N)	13
31	21	39	12	103

¹N = No treatment, P = propiconazole, T = triadimefon.

²(--) First letter for winter wheat, second letter spring wheat.

The registered labels on both fungicides specified that long-sleeved shirts, trousers or coveralls and gloves must be worn during the handling and application of the fungicides. The survey showed that of the 69 growers who used their permits, 9 either used no protective gear or declined to answer the

question (Table 4). Sixty of the 69 applicators wore some form of protection, and 49 wore adequate or better protection. Of these 49, 36 applicators wore at least the minimum required protective gear as specified on the labels and 13 wore full protection.

The recommended application rate for Bayleton^R was between 250-550 g/ha. The survey revealed that permit holders applied the low end of the application and used on average 283 g/ha. Only 2 of the 32 permit holders applying Bayleton^R exceeded the maximum rate of 550 g/ha. The maximum label application rate for Tilt^R was 500 ml/ha. The 62 permit holders used on average 482 ml/ha; seven of the 62 permit holders exceeded the 500 ml/ha. The 9 permit holders exceeding the recommended rate for either Bayleton^R or Tilt^R had non-detectable residue levels on the wheat straw at harvest time.

Table 3. Persons applying fungicides for the 69 growers with permits who purchased and applied the fungicides.

Applicator	Number of Growers		
	Triadimefon	Propiconazole	Total
Permit holder	23	47	47
Custom applicator	5	7	12
Family member	3	7	7
Neighbour, etc.	2	1	2
Total	33 ¹	62 ¹	69

¹26 growers used the two fungicides

Table 4. Protective clothing worn by 69 applicators when applying two fungicides to wheat.

Protective Clothing	Number of Applicators
None, or answer refused	9
Minimum requirement ¹	36
Full protection ²	13
1. Long sleeves	39
2. Trousers	43
3. Coveralls	19
4. Gloves	55
5. Boots	43
6. Mask	20

¹Long sleeves, gloves and trousers or coveralls

²Minimum requirements plus boots and mask

The Ontario Ministry of the Environment authorized an amount of fungicide for purchase and use based on two applications of propiconazole and one of triadimefon at the highest label rate. The survey revealed that the actual total amount of Bayleton[®] and Tilt[®] used was well below the authorized amount. Of the 857 kg of Bayleton[®] authorized for purchase and use, only 293 kg was actually applied on hard red winter wheat. For Tilt[®], 1422 litres out of an allowed 5228 litres were actually applied on both hard red winter and soft white spring wheat.

The labels of both chemicals required a minimum 2-day interval before re-entry into the treated fields. Following the treatment of the crop, only 19 of the 69 growers (or 27.5%) verbally notified people to refrain from entering the treated areas. Of the 19 who did advise others against re-entry, 15 growers informed persons not to enter for at least 3 days.

Sixty-nine cereal straw and surfacial soil samples were collected. Samples were analysed for both triadimefon and triadimenol, where Bayleton[®] had been applied, and propiconazole, where Tilt[®] was used. The analytical results appear in Table 5. No Maximum Residue Limit (MRL) for the three residues has been established for grain therefore under the Food and Drug Act (Anonymous 1988) residues should be below 0.1 mg/kg. In the 69 cereal straw samples no residues were above the detection limit of 0.05 mg/kg. Forty-two of the 69 soil samples had detectable residues that were above 0.01 mg/kg.

The pre-harvest interval (PHI) that is the number of days between the last application and harvest, was specified on the label at 60 days for triadimefon and 45 days for propiconazole. The results of the survey appear in Table 6. A percentage of the growers sprayed too late and did not allow time for the PHI to elapse before harvesting. In spite of these violations no growers had harvested cereals that had residues of triadimefon, triadimenol or propiconazole that exceeded the 0.1 mg/kg.

Table 5. Residues of triadimefon, triadimenol and propiconazole in soil samples taken from treated fields at harvest time.

Items	Fungicide Treatment	
	Triadimefon	Propiconazole
Sample numbers	33	62
Number with residues <0.01 ug/g	28	25
Number with residues ≥0.01 ug/g	5	37
Residues ≥0.01		
Parent mean ± SE (ug/g)	0.04±0.02	0.24±0.04
Metabolite mean + SE (ug/g) Triadimenol	0.07±0.03	
Minimum (Parent + Metabolite) ug/g	0.03	0.05
Maximum (Parent + Metabolite) ug/g	0.18	1.10

Table 6. Days allowed following application and before harvesting among 69 growers.

Fungicide	Wheat	Growers ¹ Number	Pre-harvest label	Interval (days) (farm level)	Growers harvesting before PHI
Triadimefon	Hard red winter	33	60	72 \pm 16	5
Propiconazole	Hard red winter	34	45	54 \pm 14	9
	Soft white spring	39	45	49 \pm 12	10

¹11 growers grew and treated both types of wheat with propiconazole and 26 growers used both fungicides.

A statistical analysis of the growers' ratings of the efficacies of the two fungicides on controlling diseases when used separately or together yielded interesting results. On a scale of 1 (not effective) to 5 (very effective), the average efficacies for triadimefon and propiconazole used separately were 4.0 and 3.9 respectively. The mean efficacy of the two fungicides applied together was 4.5.

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