



DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

HCB RESIDUES IN WHEAT

P.R. GUNNER

Report No. 13

February, 1970.

HCB RESIDUES IN WHEAT

SUMMARY:

The continued presence of low but significant amounts of HCB in both egg pulp and wheat based poultry rations has led to concern over the mechanisms of HCB contamination of wheat. A possible mechanism is the systemic movement of HCB from treated seed into the wheat land. The presence and extent of HCB translocation and the persistence of HCB residues in the soil were assessed.

Wheat grown from treated seed contained a residue of 0.0033 p.p.m. HCB, while from untreated seed a residue of 0.0022 p.p.m. HCB. Thus levels of 0.01 p.p.m. HCB or greater in wheat are unlikely to result from the systemic movement of HCB.

HCB levels in the soil for the treated plot fell from 0.015 p.p.m. at sowing to at harvest 0.0033 p.p.m. which was the general background level from the untreated plot. HCB is relatively non-persistent in the soil as would be expected from its vapour action as a fungicide.

HCB RESIDUES IN WHEAT

I. INTRODUCTION:

Hexachlorbenzene is a fungicide widely used as a seed treatment for the control of bunt (Tilletia spp.). In South Australia control of this disease relies almost exclusively on the use of HCB.

As HCB is an organic chlorine compound, concern has arisen as to residues occurring both in harvested grain and subsequently in animal products (in particular eggs).

Australian residue surveys conducted by the Department of Primary Industry have found HCB residues, for which there is at present a nil tolerance, to occur in low but significant amounts in samples of egg pulp taken from all states.

An analysis survey of 34 samples of poultry feed by the South Australian Department of Agriculture in January, 1968 showed HCB residues to occur in 6 samples all of which contained wheat in the ration. The highest value (0.08 p.p.m.) came from a feed with a relatively high proportion of wheat. Similarly a survey in August, 1967 by the Department of Primary Industry had found significant quantities of HCB to occur in samples of laying mash and wheat taken from various produce merchants.

From this it would appear that HCB residues are occurring in wheat in low but measurable amounts. Three mechanisms of contamination can be postulated.

- (1) Surplus treated seed wheat can be handled in three ways:-
 - (a) Retained for sowing following year's crop,
 - (b) fed to livestock and poultry,
 - (c) mixed with other grain (untreated) and delivered to silos and feed merchants.

With the latter, serious implications arise. As treated wheat would theoretically contain approximately 300 p.p.m. HCB, this practice need only occur to a limited extent for a significant residue to occur in bulked wheat.

- (2) Contamination at harvest from machinery, bags, etc., or during temporary storage or transport. Such contamination, if occurring, could be easily overcome by better hygiene.
- (3) Systemic movement of HCB from the treated seed into the harvested wheat head. Translocation is not a necessary part of fungicidal action of HCB which acts through sublimation. Siang and Holton (Plant Disease Reporter 1953)

attributed the control of bunt by HCB to the inhibitory action of vapour on spore germination.

To test the hypothesis of the systemic movement of HCB, a simple preliminary investigation was made by P.M. Barrow (S.A. Dept. of Agric.) during the harvest period 1967-68. Samples were collected of wheat heads grown from seed which had been treated commercially with HCB dust. Analysis indicated that for the two varieties tested Heron and Pinnacle residues of less than 0.01 p.p.m. were present (limit of detection 0.002 p.p.m.). This yield of between 2 and 10 parts per 10⁶ was calculated to account for approximately 0.1% of the HCB applied to the seed.

A recent survey (1968 harvest) for HCB residues in samples of commercial wheat taken from terminal silos throughout Australia was carried out by the Department of Primary Industry. The results showed that in all states, except Victoria, that 40% of the samples contained more than a trace (less than 0.005 p.p.m.) of HCB. Of this 40% (16 samples), 12 contained 0.01 p.p.m., 3 contained 0.02 p.p.m. and 1 contained 0.24 p.p.m. In Victoria all samples, which were taken from the one terminal, registered between 0.01 p.p.m. and 0.05 p.p.m. HCB.

Thus the results of the preliminary investigation could account for most of the levels found in wheat from terminal silos. To further test the systemic movement of HCB, a trial was carried out at Northfield Research Centre where treated and untreated wheat was compared.

II. AIMS:

- (1) To test the presence and extent of translocation of HCB from treated seed wheat into the harvested grain.
- (2) To examine whether soil residues result from the sowing of treated seed wheat.

III. METHODS:

Treated and untreated Chile IB wheat was sown to plots 1/10 acre in area. The wheat was treated with 2 oz. per bushel of Hexcebut^(R) (30% W/W hexachlorbenzene). Each treatment was applied to one plot which was divided into 3 sub-plots for sampling.

Soil samples were taken pre-sowing (19/6/68), immediately post sowing (26/6/68) and at harvest (15/12/68). Each sample constituted a volume 12" long x 6" wide x 4" deep of the soil profile and across 2 drill rows. Three samples were taken from each sub-plot which were then bulked, air-dried, ground, sub-sampled and analysed for HCB residues.

Wheat samples of 20 heads were taken at harvest. Similarly 3 samples were taken from each sub-plot which were than bulked, ground, sub-sampled and analysed. Residue levels in the treated and untreated grain at sowing were also determined.

All analyses were conducted by the South Australian Department of Chemistry. Samples were extracted with hexane in a soxhlet, cleaned up by channel layer chromatography and final analysis by gas chromatography. No evaporations were involved so that an HCB recovery of 85% was obtained.

Care was taken at all stages to eliminate any chance of contamination.

IV. RESULTS:

Ave. HCB Residue Levels

Wheat

Treatment	HCB (p.p.m.)	
	Sowing	Harvest
HCB treated	416.00	0.0033
Untreated	0.44	0.0022

Treatment	HCB (p.p.m.)		
	Pre-sowing	Post-sowing	Harvest
HCB treated	0.002	0.015	< 0.003
Untreated	0.002	0.002	< 0.003

As the crop was an abnormally high yielding (80 bush./acre), a larger dilution factor in the wheat head than in most years would be expected. The level of 0.0033 p.p.m. in the treated wheat represents an uptake of approximately 0.04%.

V. DISCUSSION:

(a) Wheat

Levels found in the treated wheat at harvest indicate that HCB levels of 0.01 p.p.m. or greater, as found in wheat delivered to silos, are unlikely to result from the systemic movement of HCB.

However, where levels < 0.005 p.p.m. (described as a trace) were found this could be due to the systemic movement of HCB. It would appear that between 0.01 and 0.1% of the HCB dust applied to the seed may be translocated into the grain.

A most significant feature was the level (0.0022 p.p.m.) which occurred in grain grown from untreated wheat, i.e. the general background level. Although this level was low it was measurable and not greatly less than the residue on wheat grown from treated seed. One anomaly that did occur was the fact that the untreated wheat had a residue of 0.44 p.p.m. of HCB at sowing. Whether this residue was responsible for the residue in the wheat head cannot be determined.

The presence of this residue on the untreated wheat did, however, illustrate one point. The Chile IB wheat was grown in the previous season from seed treated with 1 oz. per bushel of Hexcebut^(R) and had no further deliberate contact with HCB or HCB treated wheat. Thus accidental contamination must have occurred either at harvest or during transport or storage. The details of these operations are not available but the fact that some contamination has occurred here is evident.

Another residue which occurred in the harvested grain was that of lindane. Analysis of the soil pre-sowing, post-sowing and at harvest and of the wheat at sowing revealed no lindane to be present. However, the harvested grain contained lindane residues both from the untreated (0.22 p.p.m.) and the treated (0.20 p.p.m.) plots. The presence of this residue cannot be explained from the data available. Although lindane is closely related in structure to HCB, why should it appear only in the wheat head and to the same extent from both untreated and treated plots?

(b) Soil

The paddock in which the trial was conducted had not been sown with treated wheat since 1963 (as far back as records were available). Thus the HCB residues (0.002 p.p.m.) found pre-sowing occurred as a general background level which is always likely to be present. Sowing of HCB treated wheat raised the residue to 0.015 p.p.m. immediately post-sowing. However, this residue had reduced to the background level by harvest (5½ months later). From this it appears that HCB does not persist in the soil as would be suggested by its sublimation action as a fungicide.

VI. FURTHER WORK:

While it has been reasonably demonstrated that the higher level HCB contamination that is occurring in wheat at terminal silos is not due to the systemic movement of HCB, the exact cause has yet to be clearly shown. If a residue of 0.01 p.p.m. HCB is found in wheat at a terminal silo, this may be a result of a few farmers delivering wheat highly contaminated with HCB thus contaminating the bulked wheat, or of all farmers delivering wheat containing approximately 0.01 p.p.m. HCB. If the former were occurring, this would suggest the delivery of surplus treated seed wheat, but the latter, suggests a general contamination which could result from a number of sources. To elucidate this problem, wheat from individual farmers at delivery should be sampled and analysed and where very high HCB levels occur, the causes should be investigated.