VII. RESEARCH NOTES

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1) Resistance to *Heliothis armigera* and *Heliothis punctigera* in three soybean lines.

Multiple insect resistance has been detected in the soybean lines PI 171,451, PI 227,687 and PI 229,358 (Van Duyn *et al.*, 1971; Clark *et al.*, 1972; Hatchett *et al.*, 1976). In particular Hatchett *et al.* (1976) demonstrated resistance to *Heliothis zea* and *Heliothis virescens* in all three lines. On the basis of percentage larval mortality, PI 171,451 and PI 229,358 were more resistant to *H. zea* than *H. virescens*, while PI 227,687 was equally resistant to both species and also showed superior levels of resistance.

A laboratory feeding trial was conducted to determine if these three soybean genotypes were also resistant to the Australian *Heliothis* species, *H. armigera* and *H. punctigera*.

Materials and Methods: Seedlings of PI 171,451, PI 227,687, PI 229,358 and 'Bragg' were grown in the glasshouse. When they reached the second trifoliate stage individual leaves and newly hatched larvae were placed in petri dishes. The cultures were maintained in a controlled environment room at 28°C. Leaves were replenished as necessary from the same plants for the duration of the test.

Thirty six larvae of *H. punctigera* and 18 larvae of *H. armigera* were tested on each plant genotype. Larval weight, mortality, pupal weight and time to pupation were recorded.

Results and Discussions: All three resistant genotypes have greater resistance to both *Heliothis* species than does Bragg. All three were also more effective against *H. punctigera* than *H. armigera* in terms of total mortality but this was not evident in the larval weight data.

Larval weights at day 11 are listed in Table 1. Larvae of *H. armigera* were 3-4 times larger than those of *H. punctigera*. This indicates that "non-resistant" soybean genotypes have an inhibiting effect on growth of *H. punctigera*, since larvae of both species fed on artificial diet are of approximately equal weight. Larvae fed on PI 227,687 were smaller than for the other resistant types suggesting a greater level of resistance for this genotype especially to *H. punctigera*.

Larval mortality occurred at two distinct times. There was considerable mortality in the first four to six days of feeding particularly for *H. punctigera*. A second incidence of mortality occurred just prior to pupation in both species. The mortality figures listed in Table 2 show that all three resistant genotypes were effective against *H. punctigera*. PI 227,687 was superior to the other genotypes in its resistance to *H. armigera*.

Time of pupation was lengthened for the surviving larvae on the resistant genotypes compared with Bragg. For *H. armigera* pupation on the resistant genotypes was delayed by four days. The *H. punctigera* larvae which survived on PI 171,451 were delayed by four days compared with Bragg.

Table 1

Mean weights (mg) of surviving larvae of H. armigera and H. punctigera after 11 days growth on four soybean genotypes

Genotype	Insect species	
	H. armigera	H. punctigera
PI 171,451	587	249
PI 227,687	489	88
PI 229,358	876	211
Bragg	1277	387

Table 2

Percent mortality of H. armigera and H. punctigera at day 11 and pupation for four soybean genotypes

Genotype	Insect species	
	H. armigera	H. punctigera
	---------- Day 11 ----------	
PI 171,451	6	36
PI 227,687	6	65
PI 229,358	12	62
Bragg	0	12
	---------- Pupation ----------	
PI 171,451	28	89
PI 227,687	56	100
PI 229,358	39	100
Bragg	6	56

Hatchett et al. (1976) found no larvae of H. zea or H. virescens survived on PI 227,687 and that this line may have a different genetic basis for resistance than the other two lines. In this trial, the resistance shown by PI 227,687 was the most effective although some larvae of H. armigera did reach pupation. The use of PI 227,687 in breeding for resistance to H. armigera and H. punctigera would be expected to be effective.

References

Clark, W. J., F. A. Harris, F. G. Maxwell and E. E. Hartwig. 1972. Resistance of certain soybean cultivars to bean leaf beetle, striped blister beetle and bollworm. J. Econ. Entomol. 65: 1669-1672.

Hatchett, J. H., G. L. Beland and E. E. Hartwig. 1976. Leaf-feeding resistance to bollworm and tobacco budworm in three soybean plant introductions. Crop Sci. 16: 277-280.

Van Duyn, J. W., S. G. Turnipseed and J. D. Maxwell. 1971. Resistance in soybeans to the Mexican bean beetle. I. Sources of resistance. Crop Sci. 11: 572-573.

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2) Response of four soybean varieties to foliar zinc fertilizer.

Zinc deficiency symptoms are commonly encountered in irrigated soybean crops grown on grey self-mulching clay soils in Northern N.S.W. These experiments aimed to (1) quantify the yield loss due to zinc deficiency at different sites and (2) examine the differences in genotypic sensitivity to zinc deficiency among commercially grown soybean cultivars.

Materials and Methods: Experiments were conducted at (1) Narrabri Agricultural Research Station, (2) Breeza Substation and (3) Trangie Agricultural Research Station. Zinc fertilizer was applied as a foliar spray of $ZnSO_4 \cdot 7H_2O$ at each site prior to flowering. Rate of zinc application was 4Kg/ha of Zn at Narrabri and Trangie and 8Kg/ha in two sprays of 4Kg/ha each at Breeza.

At each site the experimental design was a split plot with zinc treatments as main plots. The four commercial soybean cultivars 'Bragg', 'Lee', 'Forrest' and 'Dodds' were sown as subplots. All sites were irrigated as required, and weeds and insects controlled.

Results and Discussion: Yields for +Zn and nil Zn treatments are listed in Table 1. Response to zinc differed across sites and among varieties within each site.

Lee was the variety that showed least response to applied zinc at all three sites. However, the most responsive variety differed among sites with Dodds, Bragg and Forrest giving the greatest yield increase at Narrabri, Trangie and Breeza respectively.

The Narrabri site gave the lowest responses but these increases in yield were economically and statistically significant. The responses at this site were obtained in the absence of visible foliar symptoms of Zn deficiency.

A variety trial in an adjacent area within the same field at Breeza received an additional application of $ZnSO_4$ during ground preparation. In that trial Bragg, Forrest, Dodds and Lee yielded 3685, 3542, 3364 and 3172 Kg/ha respectively.

Table 1

Yield response (kg/ha) of four varieties at three sites with applied zinc

Variety	Zinc	Site		
		Narrabri	Trangie	Breeza
Bragg	+	3347	2106	2494
	Nil	3013	1161	549
Lee	+	2798	1771	2640
	Nil	2768	1714	1707
Forrest	+	3610	1002	2471
	Nil	3139	677	322
Dodds	+	3329	1192	2161
	Nil	2678	920	583
l.s.d. (0.05)				
Variety x Zinc means		411	309	564

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1) Soybean linkage tests.

F_2 linkage results are presented in Table 1 with a = XY, b = Xy, c = xY and d = xy for the eight gene pairs listed in the form of Xx and Yy. Percentage recombination was obtained from the ratio products following Immer and Henderson (1943). The data for each of the gene pairs gave a good fit to a 3:1 ratio.

Rps_1/rps_1 was evaluated using race 1 of Phytophthora megasperma var. sojae in hypocotyl tests of F_3 seedlings. Rmd/rmd was evaluated for adult plant resistance and susceptibility to powdery mildew using greenhouse inoculation of F_3 progenies with Microsphaera diffusa.

The previously reported possibility that Rmd/rmd is in Linkage Group 1 (Buzzell, 1978) was supported by the linkage of Fg_3/fg_3 with Rmd/rmd. Fg_3/fg_3 is between T/t and Rmd/rmd but is closer to T/t. A combined estimate using data from 'Blackhawk' x 'Kingwa' (Buzzell, 1977) and Table 1 indicates 13.6 ± 4.4% recombination between Fg_3/fg_3 and T/t.