Tolerance of navy beans to the postemergence herbicides bentazone and dinoseb

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SUMMARY

The tolerance of navy beans (*Phaseolus vulgaris*) to the postemergence application of the herbicides bentazone and dinoseb was investigated. Spraying of bentazone did not result in any adverse reaction in the navy beans. When dinoseb was applied under conditions of high temperatures, there was leaf scorching, stunting, and reduction in yield of the navy beans. The reactions to the herbicide treatments were independent of the navy bean cultivar used.

INTRODUCTION

At the commencement of this project no postemergence herbicides were registered for the control of broadleaf weeds in navy beans in Queensland. Broadleaf weeds are a problem in the navy bean industry, particularly where grass herbicides such as trifluralin have been extensively used. Apart from the competitive effect of weeds, uncontrolled weed growth at harvest can cause staining of the beans and therefore reduction in quality.

Bentazone and dinoseb are two postemergence herbicides which are used successfully for controlling broadleaf weeds in other leguminous crops in the South Burnett. Dinoseb is registered in Queensland for selective weed control in peanuts. The weeds controlled include thornapples (*Datura* spp.), wild gooseberry (*Physalis minima*) and bellvine (*Ipomoea plebeia*). The U.S. Department of Agriculture (1972) recommend applying dinoseb to navy beans at the "cracking" stage (i.e. at cotyledon emergence) for control of broadleaf weeds. Bentazone has recently been registered for selective weed control of some broadleaf weeds in soybeans in Queensland. The weeds controlled are bellvine, thornapples and Noogoora burr (*Xanthium pungens*).

This paper reports the results of three trials in which the tolerance of navy beans to the postemergence application of dinoseb and bentazone was evaluated.

GENERAL METHODS

Three trials were laid down on a red clay loam (Gn 3.12; Northcote, 1971) at the J. Bjelke-Petersen Field Station, Kingaroy, Queensland, between 1975 and 1977.

The trial sites were kept weed-free by the application of the preplant herbicide trifluralin, inter-row cultivation, and by hand chipping when required.

The trials were planted into plots 3.6 m (4 rows) x 10 m. All treatments were applied with an Oxford Precision Sprayer

operating at 210 kPa and delivering 450 ℓ/ha. The sprayer was fitted with a five-nozzle boom with size 00 Allman tips.

The herbicides used were bentazone (3-isopropyl-2,1, 3-benzo-thiadizin-4-one 2,2-dioxide) and dinoseb (2-(1-methylpropyl)-4, 6-dinitrophenol).

The grain yield was obtained by harvesting the beans from a datum area of 1.6 m (2 rows) x 8 m. Analyses of variance were carried out on the data and the herbicide treatments were compared with the control by L.S.D. tests of significance.

Trial 1

Methods - On 3 January, 1975 the navy bean cultivar Gallaroy was planted in an 8 x 4 randomized block design. The treatments listed in Table 1 were imposed. Bentazone was applied at the recommended rate for use in soybeans (1.0 kg a.i./ha) and at double this rate. Dinoseb was applied at the recommended rate for use in peanuts (2.25 kg a.i./ha).

Results - Application of the herbicide bentazone at both growth stages and at both rates resulted in no adverse reaction by the navy beans. There was no significant reduction in grain yield resulting from the herbicide treatments when compared with the control (Table 1). Similarly, treatment with dinoseb at both growth stages did not cause any adverse reaction or reduction in grain yield.

Table 1. Effect of herbicide treatments on navy bean yields (Trial 1)

Herbicide	Rate (kg/ha)	Growth stage	Grain yield (kg/ha)
Control			1 263
Bentazone	1.0	1 to 2 trifoliate leaves	1 286
	2.0	1 to 2 trifoliate leaves	1 238
	1.0	early flowering	1 252
	2.0	early flowering	1 293
Dinoseb	2.25	cracking	1 460
	2.25	1 to 2 trifoliate leaves	1 372
C.V. (%)			18.1
LSD (P=0.05)			ns

ns = not significant

Trial 2

Methods - As bentazone and dinoseb looked potentially useful for navy beans, this trial was designed to evaluate the responses of different cultivars to these herbicides. The experi-

ment was set out as a 5 x 5 split plot design with four replications. The herbicide treatments as listed in Table 2 were applied to five navy bean cultivars, Gallaroy, Kerman, Selections 39, 46 and 51. The trial was planted on 15 January, 1976.

Results - The effect of the herbicide treatments was independent of the navy bean cultivars. Spraying of bentazone at both growth stages caused some temporary leaf chlorosis. There was no significant reduction in grain yield or plant height compared to the control (Table 2). When dinoseb was applied at the unifoliate leaf stage of growth, it caused severe leaf scorching. After this temporary setback, the navy beans grew normally and there was no significant stunting or yield reduction. Spraying of dinoseb at the later stage of 3 to 4 trifoliate leaves resulted in only minor leaf scorching and no reduction in yield.

Table 2. Effect of herbicide treatments on the height and yield of navy beans (Trial 2)

Herbicide and rate (kg/ha)	Growth stage	Average plant height (mm)	Grain yield (kg/ha)
Control		387	953
Bentazone 1.0	1 to 2 trifoliate leaves	387	971
	early flowering	389	899
Dinoseb 2.25	unifoliate leaf	370	876
	3 to 4 trifoliate leaves	388	947
C.V. (%)		11.0	18.3
LSD (P=0.05)		ns	ns

ns = not significant

Trial 3

Methods - As there had been an adverse reaction to the spraying of dinoseb at one of the four growth stages tried, the aim of this trial was to examine the variation in the tolerance of navy beans to the application of dinoseb at different growth stages. The recommended rate for use in peanuts and half this rate were used, as successful broadleaf weed control is being achieved in peanuts using dinoseb at half the recommended rate. On 8 February, 1977 this trial was planted in a 12 x 4 randomized block design. The treatments listed in Table 3 were imposed.

Results - Application of dinoseb at 2.25 kg/ha at all growth stages of navy beans produced leaf scorching, stunting of plants and yield reduction. There were some plant deaths resulting from the herbicide application at the first trifoliate leaf stage (Table 3).

Table 3. Effect of dinoseb treatments on the height, population and yield of navy beans (Trial 3)

Herbicide and rate (kg/ha)	Growth stage	Average plant height (mm)	Plant population (per ha)	Grain yield (kg/ha)
Control		401	149 044	1063.3
Dinoseb 1.12	Unifoliate leaf	378 *	153 471	1001.2
	1 Trifoliate leaf	345 *	134 200	868.1 *
	2 Trifoliate leaves	388	147 048	1050.3
	5 to 6 Trifoliate leaves	345 *	147 221	1008.1
	Early flowering	370 *	146 874	987.8 *
Dinoseb 2.25	Unifoliate leaf	373 *	127 256 *	940.9 *
	1 Trifoliate leaf	298 *	104 513 *	644.1 *
	2 Trifoliate leaves	343 *	143 228 *	911.4 *
	5 to 6 Trifoliate leaves	298 *	155 555	871.5 *
	Early flowering	375 *	143 575	805.5 *
LSD 5% (1)		17.5	18 810	107.52
(2)		20.2	21 721	124.15
C.V. (%)		3.9	10.7	9.2

(1) For comparisons with control

(2) For all other comparisons

* These values are significantly less than the control using LSD (P=0.05)

Dinoseb at 1.12 kg/ha caused leaf scorching to a lesser extent and stunting of plants at all growth stages except at the second trifoliate leaf stage. Significant yield reduction occurred at the first trifoliate leaf stage.

As the reaction of dinoseb at particular growth stages has varied between years, the tolerance of navy beans does not appear to depend on the stage of growth at the time of application. The activity of herbicides is often affected by the climatic conditions under which they are applied. Meggitt et al, (1954) reported that the activity of dinoseb increased as the temperature after treatment increased from 15°C to 35°C.

The dinoseb treatments over the three seasons were applied over a range of temperature conditions, as measured by the maximum temperature of the day of application. At growth stages where leaves had emerged (i.e. all except the cracking stage), the severity of reaction of the navy beans increased with increasing daily maximum temperature. Therefore the activity of dinoseb on

navy beans appears to be affected by the temperature of the day of application.

Using the results from the last three seasons, the response trend of significant grain yield reduction with daily maximum temperature at application, was calculated using simple linear regression. This produced the significant regression equation of $Y = 6.0 X - 154$ where Y is the yield reduction and X is the maximum temperature ($R^2 = 0.65$, X from 25.0 to 31.0). This response trend is shown in Figure 1.

DISCUSSION

Application of bentazone over two seasons resulted in no phytotoxic reaction by the navy beans. Therefore, as bentazone successfully controls a number of broadleaf weeds, it is a potentially useful herbicide for this crop. Subsequent to the release of the results of Trial 1 and other work, bentazone was registered for use in Gallaroy and Kerman navy beans in Queensland. Application for registration for use in all navy bean cultivars has been submitted.

The activity of dinoseb on navy beans is affected by the temperature of the day of application. From the regression equation there is no yield reduction when dinoseb at 2.25 kg/ha is applied at a maximum temperature of 26^0C or less. At temperatures above 26^0C, yield reduction is likely, and the degree of reduction increases linearly as the temperature increases. There are adverse reactions to the application of dinoseb at the lower rate but to a lesser extent. As yield reduction occurs at temperatures which are likely to be experienced during the navy bean growing season, dinoseb is not a suitable herbicide for this crop.

REFERENCES

Meggitt, W.F., Aldrich, R., and Shaw, W.C. (1954).- Factors affecting the herbicidal action of aqueous sprays of salts of 4,6-dinitro-ortho-secondary butyl phenol. *Weeds* 4 : 131-38.

Northcote, K.H. (1971).- "A Factual Key for the Recognition of Australian Soils". Rellim Technical Publications, Glenside, S.A.

U.S. Department of Agriculture (1972).- "Guidelines for Weed Control", Agriculture Handbook 447 U.S. Government Printing Office : Washington.

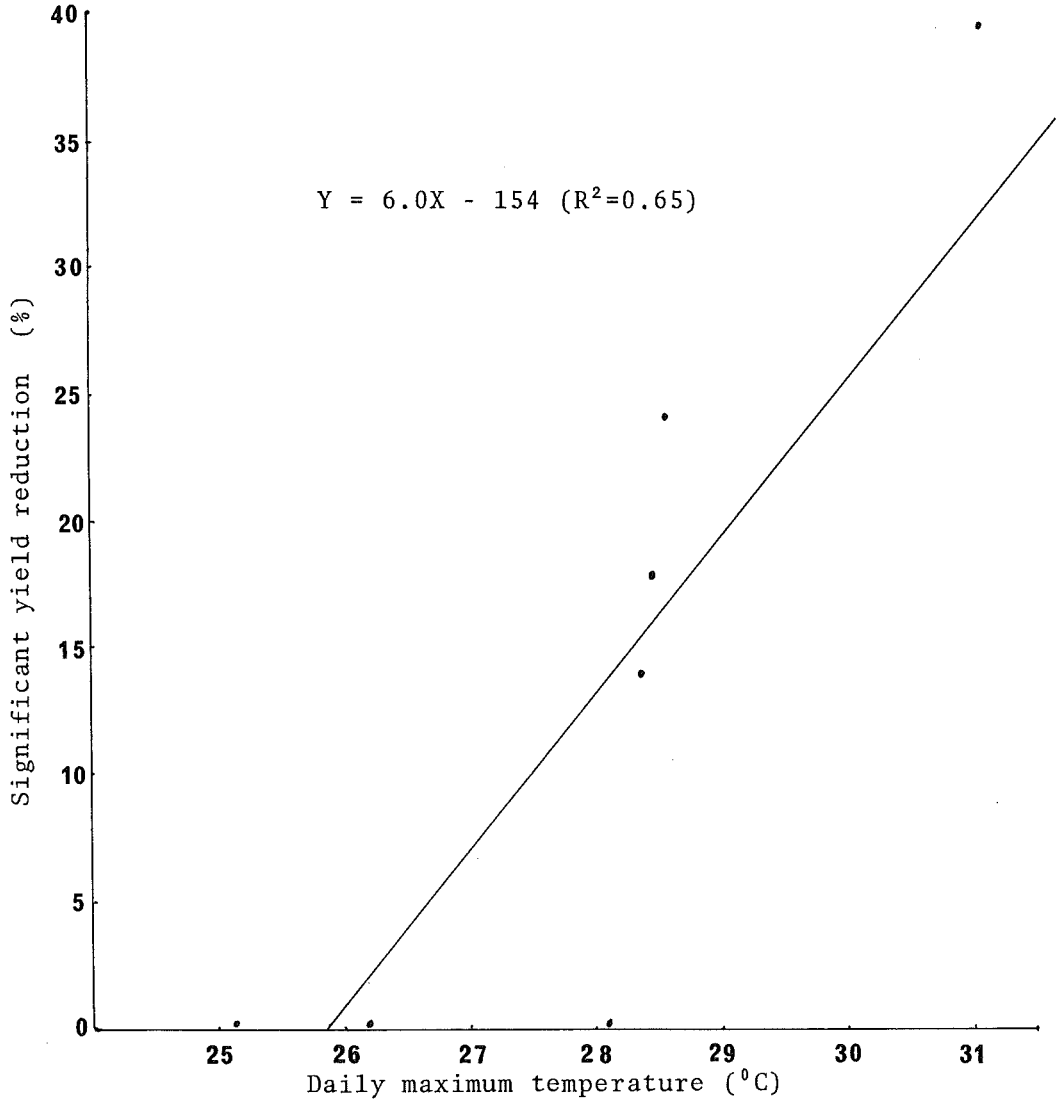

Figure 1. Relationship of navy bean yield reduction with maximum temperature of day of application of dinoseb at 2.25 kg/ha.