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NOTES

COTTON RESISTANCE TO 2,4-DICHLOROPHENOXY ACETIC ACID SPRAY DRIFT[1]

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Abstract

Cotton (*Gossypium hirsutum* L.) is very sensitive to the phenoxy herbicides, in particular, 2,4-dichlorophenoxy acetic acid (2,4-D). This sensitivity results in damage causing significant economic loss each year. A study was conducted at the Texas Agricultural Experiment Station, Etter, TX, on a sherm silty clay loam soil (fine, mixed, mesic, Torrertic Paleustoll) in 1981 and 1982 to determine if there were genetic variability for resistance to 2,4,-D damage. Twelve medium-early and early cultivars of cotton were grown under limited irrigation. In mid-June of each year, the cultivars were exposed to 2,4-D drift from farmer applications on neighboring fields. One cultivar, Paymaster 145, consistantly showed less 2,4-D damage and correspondingly higher yields. Gin turnout and micronaire were also negatively correlated with 2,4-D damage, while staple length was positively correlated.

Additional index words: 2,4-dichlorophenoxy acetic acid, Phytotoxicity, Herbicide damage, Plant growth regulator.

COTTON (*Gossypium hirsutum* L.) is a major economic crop of the southern USA. A major consideration in the production of cotton is its sensitivity to phenoxy herbicides, especially 2,4-dichlorophenoxy acetic acid (2,4-D) (Staten, 1946; Bhatt, 1957). This problem is amplified in an area where many crops not sensitive to 2,4-D are grown and the herbicide is used for weed control in those crops. Moffett (1980) reported that concentrations of 2,4-D as low as 10 mg kg^{-1} resulted in visible leaf damage when applied at flowering. McIlrath et al. (1953) reported that seedling cotton was more sensitive to minute quantities of 2,4-D than older plants. Thus, damage resulted in reduced yields from herbicide drift from 2,4-D application a considerable distance upwind from cotton fields. Day et al., (1959) further reported that 2,4-D could volatilize from the soil surface and cause damage to cotton plants. Increased resistance to 2,4-D would be a tremendous economic advantage to cotton production in these areas. Hence, the objective of this research was to evaluate cultivars of cotton for resistance to damage from 2,4-D drift. This objective was achieved by planting these varieties in an area in which 2,4-D drift occurred annually, rating the severity of the damage, and determining correlation of rating to yield and quality.

Materials and Methods

Twelve cultivars of cotton, listed in Table 1, were planted on 20 May 1981 and 1982 at the Texas Agricultural Experiment Station, Etter, TX. Cotton seeds were planted in 4 by 33 m plots on beds with furrows spaced 1 m apart at the rate of 28 kg ha^{-1}. The study was conducted in a randomized complete block with three replications. Plots received only a preplant irrigation of 12.7 cm water. Rainfall during the growing season was 30.5 and 36.4 cm in 1981 and 1982, respectively. The 2,4-D drift came in June of each year from aerial applications made by farmers on neighboring fields. Damage ratings, on a scale of 1 to 5, were taken on 18 August of each year of the study. Yields were taken from the center two rows with a mechanical stripper. Gin turnout was determined, and samples were rated for sample length and micronaire. The data were analyzed by analysis of variance.

Table 1. Mean cotton 2,4-D damage rating, yield, and quality parameters of 1981 and 1982 study, North Plains Research Field, Etter, TX.

Cultivar	Yield	Gin turnout	Staple length	Micronaire	Rating for 2,4-D damage†
	kg ha^{-1}	%	mm	Indices	
'Paymaster 145'	454a‡	21ab	23.7e	3.75a	2.4c
'Pioneer PR-80'	401ab	17bc	24.3cde	3.48b	3.5b
'Paymaster 792'	398ab	18abc	24.5cde	3.50b	3.6b
'Tamcot SP-21'	381bc	16c	25.0bc	2.97d	3.8b
'Tamcot CAMD-E'	381bc	19abc	24.1cde	3.17cd	3.6b
'Earlycot 48'	367bcd	18abc	25.0bc	3.35bc	3.5b
'D & PL SR-4'	359bcd	22a	22.9f	3.51b	3.7b
'Dunn 120'	345bcd	16c	24.9bcd	3.01d	3.7b
'Paymaster 404'	339bcd	16c	24.3cde	3.38bc	3.9b
'Cascot BR-1'	333bcd	18abc	25.0bc	3.33bc	3.5b
'McNair 307'	314cd	15c	26.1a	3.23bcd	4.0ab
'G & P 3774'	302d	15c	25.5ab	3.07d	4.5a

† 1 = no damage, 5 = extensive damage.
‡ Values within a column followed by the same letter are not significantly different using Duncan's new multiple range test, $p = 0.05$.

Table 2. Correlation of damage rating, yield, and quality parameters.

	Yield	Gin turnout	Staple length	Micronaire	Damage rating
Yield	1.0	0.777†	−0.341**	0.402‡	−0.861†
Gin turnout		1.0	−0.471†	0.506†	−0.653†
Staple length			1.0	0.417‡	0.375‡
Micronaire				1.0	−0.453†

** Significant at $P > 0.01$.
† Significant at $P > 0.0001$.
‡ Significant at $P > 0.001$.

Results and Discussion

Means of yield, fiber properties, and 2,4-D spray drift damage ratings are shown in Table 1. Considerably more damage occurred in 1982 than in 1981. The overall mean ratings were 2.5 and 4.7 for 1981 and 1982, respectively. However, no significant cultivar × year interaction occurred, indicating that susceptibility to 2.4-D damage is a highly heritable trait. The 2-yr average damage rating of G & P 3774 was significantly higher than other cultivars, except McNair 307. The most dramatic and important result was that Paymaster 145 had substantially and significantly less 2,4-D damage than any of the other cultivars in the trial.

Yield, gin turnout, staple length, and micronaire were highly correlated with 2,4-D damage rating (Table 2).

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The cultivars ranked differently for yield than in other studies conducted in the absence of 2,4-D, further suggesting a definite effect of 2,4-D drift on yield (Gannaway et al., 1982, 1983). Paymaster 145 , with the lowest 2,4-D damage, consistently had the highest lint gin turnout, yield, and micronaire. G & P 3744, with the highest 2,4-D damage rating, had the lowest yield and micronaire during the 2 yrs of the trial. Staple length was positively correlated with 2,4-D damage. This is likely a result of the associated reduced yield.

In summary, in a trial conducted for 2 yrs at the North Plains Research Field of the Texas Agricultural Experiment Station, Paymaster 145 consistently had a lower 2,4-D damage rating and a higher yield than other cultivars evaluated, while G & P 3744 consistently had a higher 2,4-D damage rating and lower yield than other cultivars in the study. The large differences observed and the consistency over years would indicate that a degree of genetic tolerance to 2,4-D damage exists in Paymaster 145. Cotton production risk could be reduced by selecting resistant cultivars for use in areas of high probability of 2,4-D drift.

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EVALUATION OF POLYCROSS PROGENIES OF CICER MILKVETCH FOR PALATABILITY BY SHEEP[1]

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Abstract

Cicer milkvetch (*Astragalus cicer* L.), a nonbloat-inducing forage legume, has many traits that make it a potentially desirable species. Relatively little information, however, is available on animal acceptance of cicer milkvetch forage. The objective of this study was to determine if the component polycross progenies of 'Monarch' differed in palatability as measured by grazing sheep (*Ovis aries*) offered a choice of progenies. The progenies were evaluated in a space-planted, irrigated nursery during three grazing cycles in 1980 and two grazing cycles in 1981. Progenies differed significantly ($P \leq 0.05$) for grazing score (palatability) during four of the five cycles. Several progenies ranked consistently high for palatability, while other progenies ranked consistently low. None of the Monarch progenies, however, were significantly more palatable than 'Lutana'. All sheep remained healthy and suffered no observable side effects during the course of the study. Plant height, vigor, and flowering score were not related to palatability of progenies. The results suggest that it may be possible to improve the palatability of cicer milkvetch by breeding and selection.

***Additional index words:* *Astragalus cicer* L., Forage quality, Forage breeding.**

CICER milkvetch (*Astragalus cicer* L.), a relatively new forage legume, has many desirable agronomic characters. Forage quality is excellent when measured by laboratory procedures such as crude protein, in vitro dry matter digestibility, cell wall constituents, lignin, hemicellulose, cellulose, and silica (Townsend et al., 1978). Sheep (*Ovis aries*) fed a cicer milkvetch-mixed hay diet for 52 consecutive days remained healthy and suffered no observable side effects (Wegert, 1977). The forage does not contain toxic levels of nitro compounds (Williams et al., 1976), tannins, oxalates, alkaloids (Davis, 1973), or Se (Davis, 1972; Johnston et al., 1975). Although excessive foam formation has been noted in in vitro studies (Cooper et al., 1966), no cases of bloat in animals grazing the forage have been reported. Leaf cell rupture studies with bloat-safe legumes [cicer milkvetch, sainfoin (*Onobrychis viciifolia* Scop.), and birdsfoot trefoil (*Lotus corniculatus* L.)], and bloat-inducing legumes [alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and white clover (*T. repens* L.)] demonstrated that the cell walls of bloat-safe legumes are more resistant to mechanical rupture and to disruption by rumen microorganisms than the cell walls of bloat-causing legumes (Howarth et al., 1978, 1982).

Relatively few grazing studies have been conducted with cicer milkvetch. In a high-altitude irrigated meadow in Colorado, grass-cicer milkvetch pastures produced 83% as much beef per hectare as N-fertilized (112 kg/ha actual N) grass pastures (Rumburg, 1978). In an irrigated study in Nebraska, a pure stand of cicer milkvetch produced significantly less beef per hectare than did a pure stand of alfalfa, an alfalfa-grass mixture, a cicer milkvetch-grass mixture, and grass alone (Nichols et al., 1982). The two grass-legume mixtures and the grass-alone treatments were fertilized with 168 and 280 kg of actual N/ha, respectively. Under irrigation in Wyoming, a cicer milkvetch-creeping foxtail (*Alopecurus arundinaceus* Poir.) mixture produced more beef per hectare than a sainfoin-creeping foxtail mixture (Seamands et al., 1972).

In western Canada, pure stands of five forage species [Kentucky bluegrass (*Poa pratensis* L.), reed canarygrass (*Phalaris arundinacea* L.), orchardgrass (*Dactylis glomerata* L.), sainfoin, and cicer milkvetch) were

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