The potential of summer crops to affect weed growth

E. Jones, R.S. Jessop, and B.M. Sindel

CRC for Weed Management Systems, University of New England, Armidale, NSW 2351.

ABSTRACT

There has been a shift in production practices toward integrated pest control. One tool that may be incorporated is the use of potentially allelopathic crops to aid in the control of weeds. The aim of this study was to screen a range of crops that display allelopathic potential for incorporation into rotations for this purpose. Trials sown at the University of New England, Armidale, consisted of azuki bean, cowpea, mungbean, navy bean, sorghum, soybean, sunflower and a fallowed control. Groundcover of weeds was assessed 8 weeks after crops were harvested. Apart from the fallow, cowpea lead to the highest cover of grass weeds at 23.6%. Soybean had the lowest weed ground cover of 3.7% cover in broadleaf weeds and 1.1% of grass weeds. Sorghum displayed a stimulatory effect on broadleaf weeds at 70% cover; it had the highest percentage of broadleaf weeds. There are indications that the inclusion of soybeans in a crop rotation may help to suppress weed growth and give a competitive advantage to winter crops.

Key words

Allelopathy, weed control, soybean, sorghum.

INTRODUCTION

As the concept of sustainability has emerged, producers have moved towards conservation methods of farming. However, in some parts of Australia, adoption of conservation and reduced tillage methods has been relatively slow as farmers are faced with the practical and ethical difficulties of increased reliance on synthetic chemical pesticides. An increasing awareness of the potentially negative impacts that may be created by a reliance on synthetic chemicals has led to a range of weed control methods and an emphasis being placed on integrated weed management. One potential tool is the use of the natural allelopathy of certain crop species. This experiment screened a range of summer crops for potential allelopathic activity.

MATERIALS AND METHODS

Seedbeds were prepared using conventional tillage practices at the University of New England, Armidale. The experiments used a randomised split plot design with four blocks. On the 16th of December 1998, plots measuring 10 x 1.5 m were sown with a row spacing of 25 cm and at commercially recommended seed rates for the area to seven summer crops. These were sorghum (*Sorghum bicolor* cv. Patriot), sunflower (*Helianthus annuus* cv. Suncross 41), navy bean (*Phaseolus vulgaris* L. cv. Spearfelt), soybean (*Glycine max* cv. Intrepid), azuki bean (*Vigna angularis* cv. Erimo), mungbean (*Vigna radiata* cv. Emerald), cowpea (*Vigna unguiculata* cv. PRFC4A) and a fallow control. Control plots were cultivated in the same manner as the treatment plots, but were not sown to a crop. Plots were hand hoed once in early February. At crop maturity, the plots were mechanically harvested. The residues were spread evenly across the plot from which it was harvested. Plots were left for 56 days and photographs were taken of four random quadrats within each plot. To give a more accurate estimate of ground cover by weeds, plots that contained sufficient residue to obscure the soil surface were photographed both with and without residue. Photographs were interpreted by using a sheet of glass, etched with a 6 mm square grid to give point quadrat counts. Counts were divided into the categories of either grass weed, broadleaf weed, crop residue or soil.

RESULTS AND DISCUSSION

Both grass and broadleaf weeds were significantly ($p<0.05$) affected by crop residue type. Apart from the fallow, cowpea gave the highest cover of grass weeds at 23.6% whilst soybean produced the lowest cover with only 1.1%. A weak correlation exists between grass weed cover and cover by crop residue ($r^2=0.4$).

Soybean resulted in the lowest ground cover in both grass and broadleaf weeds, having only 3.7% broadleaf weed cover. There was no correlation between broadleaf weed cover and cover by crop residue ($r^2=0.09$).

Table 1. Percentages ground cover for grass, broadleaf weeds and crop residue 8 weeks after harvest of seven summer crops.

	Azuki	Cowpea	Mungbean	Navy bean	Sorghum	Soybean	Sunflower	Fallow	5% lsd
Grass	22.5	23.6	18.0	20.5	11.8	1.1	22.7	43.8	7.8
Broadleaf	41.8	25.2	44.3	34.5	70.0	3.7	22.4	51.1	18.7
Residue	23.2	40.4	29.2	33.9	63.0	77.5	32.3	0.0	10.9

The severe suppression of weed emergence and growth in soybean indicates a strong residual effect from the crop. It is possible that an allelopathic effect from the soybean plants and alteration to the growing environment from retained surface residue will have had a combined effect on weed growth. Given that soybean residue covered the soil surface only 14.5% more than the sorghum residue (Table 1), the alteration to environmental conditions on the soil surface are unlikely to have produced such a high degree of suppression in broadleaf weeds. It is therefore possible that an allelopathic effect has worked in conjunction with changed soil conditions to suppress weeds.

Plant responses to allelochemicals are generally considered negative. Broadleaf weeds were significantly stimulated by sorghum when compared with the other crop species, producing 70% cover (Table 1). At millimolar concentrations, many allelochemicals are inhibitory; however, at micromolar concentrations these same chemicals can stimulate the identical parameters of emergence and growth (1, 2). Under field conditions, active allelochemicals can be leached from the crop residues in concentrations low enough to act as a stimulant.

From these findings, there are indications that the inclusion of soybeans in a crop rotation may help to suppress weed growth and give a competitive advantage to winter crops.

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