Table II. Sugar Specificity for Inhibition of Hemagglutination[a] in PBS Extracts of Three Varieties of Grain Sorghum

sugar[b]	inhibitory act.[c]
L-arabinose	-
N-acetyl-D-glucosamine	+
D-fucose	-
D-galactose	-
D-glucose	-
D-mannose	-
D-maltose	+
D-xylose	-

[a] Hemagglutination activity determined with human A^+ RBC. [b] Final concentration of sugars was 20 mg/mL. [c] Qualitatively the same for varieties CK 60, NSA 740, and TX 615.

is critical for binding to lectins. Generally speaking, lectins interact with the nonreducing terminal glycosyl groups of polysaccharides and chain ends of glycoproteins. The complex interactions involved for different sugar–lectin systems have been reported by Goldstein and Hayes (1978) and by Allen et al. (1973).

For further investigation, lectins in varieties GA 615 and SC 301, 40-mesh samples, were defatted with hexane followed by extraction with PBS. Results of hemagglutinating tests showed that lectins in GA 615 were extractable after hexane treatment but not those in SC 301. Other experiments showed that lectins were readily extracted from GA 615 after removal of tannins with methanol. These two varieties were also tested for possible enhancement of agglutination induced by divalent cations. Lima bean lectins, for example, showed reduction in hemagglutination titers by 75% after removal of manganese ions (Galbraith and Goldstein, 1970). Other studies showed that the manganese ion is required for activity of soybean lectin (Jaffe et al., 1977). In the present study full-fat meals of GA 615 and SC 301 were extracted with PBS under normal conditions and then treated with $CaCl_2$ and $MnCl_2$ followed by hemagglutinating analyses. Both Ca^{2+} and Mn^{2+} activated the lectins in SC 301 with human blood groups A^+, A^-, O^+, and B^+. GA 615, however, showed trace activity only with cells from blood groups O^+ and A^+. Extensive research involving concanavalin A has shown that metal coordination (Ca^{2+} and Mn^{2+}) in that lectin consisted of four protein ligands and two water molecules (Gold and Balding, 1975). The resultant octahedral complex formed is undoubtedly one step in the chain of reactions leading to hemagglutination.

Undoubtedly, the carbohydrate binding sites on lectins are much more complex than may appear from inhibition studies with simple sugars and from cation activation. In this preliminary study, at least two simple sugars did bind to lectin(s) in grain sorghum. Also, divalent cations did enhance agglutination reactivities in two of the varieties. No differences existed in sugar specificities of the lectins among the varieties, and the A, B, and O human blood groups were not differentiated. The results indicate differences in extractability of lectins among the five varieties.

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Selective Toxicity of *Ocimum canum* Extract against *Cyperus rotundus* L. 1

An aqueous extract of *Ocimum canum* (hoary basil) has shown toxic activity against purple nut sedge, *Cyperus rotundus* L. In laboratory tests, the extract has no toxic effect on seed germination and growth of plants of *Vigna mungo* (L.) Hepper, *Triticum aestivum*, and *Oryza sativa*. The extract can be applied to moist or flooded soil. Characterization of the active ingredient is in progress.

Many workers (Pandey, 1980; Anon, 1977; Turner, 1977; Wills, 1976, 1977) have tested various synthetic chemicals against *Cyperus rotundus* (purple nut sedge), a noxious weed, and reported effective control with their repeated applications. However, plant products might provide an alternative source of weed control (Rizvi et al., 1980, 1981)

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Table I. Plant Response [(+) for Stimulation and (−) for Inhibition] to Extract of *O. canum* under Different Conditions of Treatment

	% change relative to control											
	C. rotundus						*T. aestivum*				*V. mungo*	
	tuber sprouting			shoot length			seed germination		shoot length		seed germination,	shoot length,
sowing	a[a]	b[b]	c[c]	a[a]	b[b]	c[c]	a[a]	b[b]	a[a]	b[b]	c[c]	c[c]
4	−52	−44	−20		−65		0	+4			+28	+13
8	−72	−52	−36		−50	−56	+4	−4	+40	+38	+8	+16
12	−68	−48	−40	−82	−46		+4	−4	+45	+24	+4	+20
16	−48	−52	−48	−81	−39	−60	+4	0	+33	+24	0	+24
20	−48	−52		−80	−45		0	0	+30	+24		
24	−48	−52		−79	−52		+4	0	+34	+25		
28	−48			−73			+4	0	+37	+27		
30	−48			−73			+4	0	+37	+27		

[a] Presoaking treatment and sown in Petri dishes. [b] Continuous soaking treatment and sown in Petri dishes. [c] Presoaking treatment and sown in pots.

Table II. Plant Response [(+) for Stimulation and (−) for Inhibition] to Extract of *O. canum* under Different Conditions of Moistening

	% change relative to control							
	C. rotundus				*T. aestivum*		*Or. sativa*	
	tuber sprouting		shoot length		seed			
after sowing	a[a]	b[b]	a[a]	b[b]	germination, a[a]	shoot length, a[a]	plant survival, b[b]	shoot length, b[b]
4	0	−8			+15	−7		
8	0	−60			+5	−3	0	0
12	−5	−100			+5	−2	0	0
16	+5	−92	+27		+5	0	0	0
20	+10	−88	+7		+5	+1		
24	0	−80	−11	−68	+5			
28	0	−80	−11	−48	+5	+2		
30	0	−76	−8	−46	+5	+2	+10	+4

[a] Ordinary moistening akin to that of a wheat crop. [b] Flooding condition akin to paddy fields.

with little or no harmful effects on crops (Wills, 1977; Fawcess and Spencer, 1970; Knuesli, 1976). In a preliminary survey of a number of plants, the extract of *Ocimum canum* (hoary basil, family Labiateae) proved interesting and has been tested further for its toxic activity against *C. rotundus*. The selectivity of the extract was assessed by its effect on seed germination and growth of *Vigna mungo* (L.) Hepper, *Triticum aestivum*, and *Oryza sativa*, the most important crop plants of the region.

MATERIALS AND METHODS

Plant Materials. For preparation of extract, healthy plants of *O. canum* were collected from the campus of Gorakhpur University. Tubers of *C. rotundus* were obtained from the Botanical Garden of Gorakhpur University, and seeds of *V. mungo* (type 9) and *T. aestivum* were purchased from Bharat Seeds Stores, Gorakhpur, India. Plants (50 days old) of *Or. sativa* (var. boro) were obtained from local paddy fields.

Preparation of Extract. Leaves and influorescence of *O. canum* were dried in sunlight. Ten liters of extract was obtained from 100 grams of dry powder heated in sufficient water on a water bath for 0.5 h with repeated extraction (3 times) of the residue left after filtration with the help of a piece of cloth. The extract was stored in glass containers and was used in toxicity studies as such.

Toxicity Studies. For both types of studied, experiments were performed either in Petri dishes (Corning, 15-cm diameter, fitted with Whatman No. 1 filter paper on a 1 cm thick layer of cotton) or in earthenware pots (30-cm diameter and 25-cm height) filled with garden soil. The extract was applied in two ways: (1) 25 tubers or seeds were presoaked in 30 mL of extract in Petri dishes (7.5-cm diameter) under laboratory conditions at ~28 °C for 24 h and then allowed to germinate and grow in Petri dishes or pots; (2) tubers and seeds were sown in Petri dishes and pots treated with 30 and 500 mL of the extract, respectively. In experiments with pots, the soil was kept either moistened akin to field conditions of wheat by regular watering or ~2.5 cm of water was allowed to stand over its surface, as in field conditions for paddy, continuously through the entire period of experimentation.

With *Or. sativa*, no germination experiments were performed. In this case, 10 plants (50 days old) were transplanted to each pot containing 10 tubers sown in it. All the experiments were performed in triplicate and repeated twice, and water served as the control. Germination counts and shoot length (average of five seedlings in each case) measurements of the seedlings were taken on alternative days, until the termination of the experiment. Only data obtained at the 4th, 8th, etc. days are, however, presented in the tables and are expressed as percent change relative to the control.

RESULTS AND DISCUSSION

Results as summarized in Table I clearly indicate that the extract of *O. canum* acts as an effective and selective inhibitor of *C. rotundus*; while inhibiting tuber sprouting and shoot length, the extract had no inhibitory effect on seed germination and seedling growth of *T. aestivum* and *V. mungo*. Similar results were obtained when presoaked tubers and seeds were sown in untreated soil (Table I). Table I also shows that the effects were similar irrespective of whether the presoaking treatment or continuous soaking was used. While treatment under the ordinarily moistened condition showed no effect, treatment under the condition

of flooding akin to the situation in the paddy field markedly retarded sprouting and seedling growth of the weed (Table II).

While isolation and identification of the active principle awaits further investigation, it can be concluded that the plant extract of *O. canum* is a potent allelopathic agent against *C. rotundus*.

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Metaldehyde Residues on and in Citrus Fruits after a Soil Broadcast of a Granular Formulation and after a Spray Application to Citrus Trees

The molluscicide metaldehyde (2,4,6,8-tetramethyl-1,3,5,7-tetroxocane) is used in California citrus groves to suppress populations of the brown garden snail *Helix aspersa* Müller. After a 56 kg ha^{-1} soil broadcast application of a 7.5% AI granular formulation, the 3-day rind samples showed a maximum residue level of 0.02 ppm of metaldehyde. The 10- and 17-day rind samples and 10-day pulp (edible portion) samples contained <0.01 ppm of metaldehyde. After an unregistered-use spray application, metaldehyde dissipated from unwashed rind with a half-life of 4.6 days during the initial 33 days of the test. Dissipation was somewhat slower during the subsequent 26 days of the test period with a half-life of 14 days. The 10-, 31-, and 59-day pulp samples contained <0.01 ppm of metaldehyde. Residue methodology developed for citrus is given in detail.

The brown garden snail, *Helix aspersa* Müller, is becoming an increasingly serious pest in California citrus orchards as a result of changing orchard management practices. The snails climb into the trees and readily attack maturing fruits. The two most common control materials in use, singly or in combination, are metaldehyde (2,4,6,8-tetramethyl-1,3,5,7-tetroxocane) and methiocarb. A granular or bran formulation is broadcasted to the soil under the trees when the snails are active, and repeated applications within a growing season are frequently required.

Although minimal residues would be expected on citrus fruits as a result of a soil broadcast, inadequate residue data are available to substantiate the assumption. This study was conducted to fill the data gap for normal use conditions. In addition, a spray application was made to determine how rapidly metaldehyde dissipates from citrus fruits.

The analytical methods for metaldehyde have been reviewed by Selim and Seiber (1973). The method reported by Selim and Seiber (1973) was modified for citrus analysis and allowed for the quantification of metaldehyde residues down to 0.01 ppm.

MATERIALS AND METHODS

Treatment. Each of the three replicate plots for each of two application methods consisted of a row of six mature Valencia orange trees. Applications were made on May 1, 1981, to plots located on the University of California Citrus Research Center, Riverside, CA.

A 200-g aliquot of a 7.5% AI metaldehyde granular formulation was broadcasted under each tree. For 115 trees $acre^{-1}$, this was 3.8 lb of AI $acre^{-1}$ (4.2 kg of AI ha^{-1}).

A 4 lb of AI metaldehyde gal^{-1} suspension called Slug-N-Snail Special Spray (Cooke Laboratory Products, Pico Rivera, CA 90660) marketed for use on ornamental plants was used to prepare a spray mix which was applied with an oscillating boom spray rig at a rate of 18.8 lb of AI $(2000\ gal)^{-1}\ acre^{-1}$ [21 kg of AI $(187\ hL^{-1})\ ha^{-1}$]. The entire tree was sprayed to obtain a uniform spray coverage of the tree for residue study purposes. A grower might use 20% of this amount, 3.8 lb of AI $(400\ gal)^{-1}\ acre^{-1}$, and spray the lower 20% portion of the tree where the snails are likely to reside.

Sampling and Processing. Each sample consisted of 20 fruits collected from the inner four trees of the plot. Samples for rind residue analysis were collected by clipping each fruit and allowing it to drop into a 3-gal jar so as to minimize the disturbance of surface residues. Samples for pulp residue analysis were collected into paper bags and washed prior to peeling to minimize contamination from surface residues. All samples were peeled and chopped on the day of sample collection. One subsample was immediately extracted and analyzed, and the remainder of the

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