TABLE

Changes in Phenol and Sugar** levels in* X. vignicola *infected Cowpea cultivars (in mg/g oven dry weight)*

Metabolites	Resistant Cv Pusa 4		Moderately susceptible V 38		Susceptible CM 11	
	Healthy	Infected	Healthy	Infected	Healthy	Infected
Total Phenols	413	442	367	389	286	304
O.D. Phenols	93	107	82	88	69	73
Reducing sugars	468	457	548	523	660	617
Non-reducing sugars	1360	1435	1435	1372	1894	1774

* in catechol equivalents.

** in glucose equivalents.

Sugars provide a carbon skeleton for the synthesis of phenolics[5]. Hence initial high levels of phenolics and low levels of carbohydrates in addition to the accumulation of high phenolics after infection play an important role in the disease resistance mechanism of cowpea plants.

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METABOLIC CHANGES IN RICE LEAVES DURING SENESCENCE

BENZIMIDAZOLE (BZI) has been observed to retard senescence in cereal crops[2,4,9,11], leguminous crops[3] and in other plants as well[5,6,14]. The present investigation is aimed at studying the metabolic changes in excised leaves of rice, *Oryza sativa*, variety ptb 10, floated on aqueous solution of BZI at 50 mg/l since this concentration had the maximum inhibiting effect of 8 days on senescence over the water controls[7].

Paper chromatography revealed distinct differences in the nature of pigments in the leaves treated with BZI from those of the water controls. Five pigments, chlorophyll *a* and *b*, lutein, xanthophyll and carotene were present in the control leaves. In the BZI-treated leaves, in addition to these pigments, two more pigments, namely neoxanthine and zeaxanthine, were noted at the stage of 50% senescence. At the tage of 100% senescence chlorophyll *a* and *b* disappeared but there appeared another additional carotenoid pigment, violaxanthine. The appearance of extra carotenoid pigments in rice leaves along with the gradual loss of chlorophyll pigments during senescence, observed here, parallels the work of Moore[8] on the leaves of virginia creeper.

BZI was able to maintain the chlorophyll at a level higher and for a period longer than that in the water controls. This corroborates the findings of Person *et al* in wheat[9] and of Yoshida *et al* in *Elodea*[14]. The action of BZI on chlorophyll retention may be due to its effect on the maintenance of the lamellar structure of the chloroplasts[12,14].

In BZI-treated leaves there were increases in total nitrogen and soluble nitrogen of 10% and 13% respectively six days after treatment over the water controls as estimated by micro-Kjeldahl method as modified by Markham[1]. Eight days after treatment with BZI the total nitrogen and soluble nitrogen increased by

48% and 254% respectively over the water controls. Corresponding increases in insoluble nitrogen in BZI-treated leaves after 6 and 8 days of treatment were 42% and 32%. The maintenance of soluble nitrogen in the leaves treated with BZI may be due to a higher rate of proteolysis induced by BZI. Since BZI is chemically similar to adenine, it may act by promoting the synthesis of RNA and nucleoproteins. The present observations are similar to the findings of Person *et al* in wheat leaves[9].

BZI effected an increase in total sugar, reducing sugar and sucrose as estimated by Somogyi's method[10]. Six days after treatment with BZI, the total sugar, reducing sugar and sucrose respectively recorded an increase of 43, 25 and 115% over the water controls. Eight days after treatment with BZI, the increases in total sugar, reducing sugar and sucrose were 196%, 263%, and 64% respectively over the water controls. The rise in total sugar, reducing sugar, and sucrose contents in the leaves treated with BZI may be due to a rapid hydrolysis of starch induced by BZI. The gradual decline in their values from those of the initial stage indicates their utilisation as respinatory substrates.

BZI induced an increase in the rate of respiration of rice leaves as measured by Warburg manometer. There were increases in respiration by 25% and 273% respectively after 6 and 8 days of treatment with BZI over the water controls. The increased rate of respiration due to BZI treament may be a sequel to the accumulation of sugars in the leaves. The present findings of a higher rate of respiration in BZI-treated leaves paralleled the work of Yamada *et al*[13].

BZI also induced an increase in the titratable acid content in the rice leaves. There were increases in titratable acid content by 58% and 84% respectively after 6 and 8 days of treatment with BZI over the water controls. Increased respiration may have resulted in the accumulation of more organic acids as shown by the increase in titratable acidity.

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EFFECT OF HERBICIDES ON THE CHLOROPHYLL CONTENT OF ISOLATED LEAVES OF *OXALIS LATIFOLIA* H.B. AND K.

Oxalis latifolia H.B. and K. was observed profusely infesting the apple nursery during the rainy season[1]. Although there are several reports on the chemical control of weeds in orchards and field crops[3,7,9,11] yet the role of different herbicides in eradication of this weed is not completely understood[2]. The present report describes the action of six herbicides on the chlorophyll content of isolated leaf discs of *Oxalis latifolia*.

Discs (1 cm^2) were punched from leaves and placed in solutions of 500, 1,000 and 1,500 ppm of alachlor (α-chloro-2′, 6-diethyl-N-methoxymethylacetanilide, Lasso), 2, 4-D, (2, 4-dichlorophenoxyacetic acid), MSMA (monosodium methanearsonate, Ansar 529), *nitrofen* (2, 4-dichloro-4′-nitrophenyl ether, Tok E-25), paraquat (1, 1′-dimethyl-4, 4′-bipyridylium ion, Gramoxone) and atrazine (2-chloro-4-ethylamino-6-isopropylamino-1, 3, 5-triazine, Atrataf). A set of control (distilled water) was also maintained. After 2, 4 and 6 hours of incubation the discs of different treatments were washed with distilled water and the optical density of each solution was measured against 80% ethanol in UV spectrophotometer at 665 mμ and 645 mμ for chlorophyll *a* and chlorophyll *b* respectively[8]. The results were confirmed by repeating the experiment three times.

Rapid degradation of chlorophyll *a* and chlorophyll *b* was observed in alachlor and atrazine followed by paraquat. Only 0·07, 0·12, 0·17 mg g^{-1} of chlorophyll *a* and 0·10, 0·13, 0·15 mg g^{-1} of chlorophyll *b* was noted in the leaf discs incubated for 6 hours in alachlor, atrazine and paraquat respectively. The herbicides 2, 4-D, MSMA and nitrofen were less effective in chlorophyll destruction showing 0·40, 0·28, 0·37 mg g^{-1} chlorophyll *a* and 0·22, 0·20,

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