STUDIES ON THE BIOLOGY OF *DERMESTES ATER* (COLEOPTERA: DERMESTIDAE)—A PEST OF SILKWORM PUPAE AND ADULTS

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In India, several species of Dermestes like *Dermestes cadaverinus* Fabricius, *Dermestes vulpinus* Fab., *Dermestes vorax* Motschulsky, *Dermestes tesselatocollis*, *Dermestes coarctatus* have been reported to damage stifled and stored cocoons[1]. In Japan, *Dermestes ater* Degeer (Coleoptera: Dermestidae) has been observed to pierce through the silkworm cocoons and feed upon the dried pupae inside[2].

This pest has been found mainly from the cut and pierced cocoon storage rooms of silkworm seed stations located in Mysore and Bangalore districts. In absence of the dead and dried pupae, the live pupae and moths are also damaged by *D. ater*. Adults and grubs of this species were collected from the National Silkworm Seed Project Grainage, Mysore and a laboratory colony has been established by providing dried silkworms pupae as food.

The adult is elongate-oval, convex and black with short clubbed antennae. Adult measures about 7 mm in body length. Preliminary observations made on this beetle revealed that the adult starts ovipositing in about 5 days after their eclosion. The egg is milky white, elongate with an average measurements of 1.90 mm in length and 0.48 mm in width. Incubation period varies from 3 to 6 days (average 4.5 days).

Newly hatched grub is white which gradually turns to brown in first instar itself. The average size of I instar grub is 2.44 mm including the head capsule which measures 0.24 mm in length. Morphologically, the different instars are similar except the variation in size. However, the colour of the grub turns to black from II instar onward. Grub of all the different ages consists of 13 segments with a distribution of 3 thoracic and 10 abdominal segments. The thoracic and abdominal segments are similar in appearance dorsally but each of the three thoracic segments typically bears a pair of legs. Grubs in general are spindle-shaped and are covered with hairs of various length. The grub undergoes 4 to 6 moults in about 27–28 days.

On an average, pupation period is 7.8 days. Freshly emerged adult changes its colour from light yellow to dark brown with the advancement in age.

All the grub stages are attracted by the odour of the stifled cocoon and pupae of silkworm. It has been observed that these grubs pierce through the cocoons and devour the dried pupae. All such pierced cocoons are rendered unfit for reeling.

Further studies on the bionomics and control of *D. ater* are in progress.

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SEED TREATMENT WITH FUNGICIDES AND SEED BACTERIZATION WITH *AZOSPIRILLUM*

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Seed protection with fungicides is a method to control seed-borne pathogens. These seed dressing chemicals besides controlling plant pathogens are likely to inhibit the activity of useful micro-organisms like *Azospirillum* which is also simultaneously inoculated on to seeds for enhancing biological fixation of nitrogen[1]. At present neither we know the extent to which it is safe to use the seed dressing chemicals without disabling *Azospirillum* nor do we know the deleterious effect caused to *Azospirillum* by these chemicals used for seed treatment. Hence a study has been undertaken to find out the influence of captan and thiram on *Azospirillum*. Captan (N-trichloro methyl thio-4-cyclohexane-1, 2-dicarboximide) 75% active ingredient and thiram (tetramethyl thiuram disulphide) 75% active ingredient were used.

Azospirillum brasilense (S.3) a double antibiotic marker strain, resistant to streptomycin and chloramphenicol (100 μg ml) and with pink chromogen obtained from Dr David Hubbell, University of Florida, Gainesville, USA, was used for seed inoculation.

Pearl millet (*Pennisetum americanum.*) seeds of the variety, X5 were treated with the fungicides captan and thiram separately @ 4 g/kg of seed. An hour after the fungicidal treatment, the seeds were treated with a peat based inoculum of *A. brasilense* and shade dried for 20 min. Another lot of the seeds of the same variety was first treated with *Azospirillum* inoculum, shade dried for 20 min and subsequently treated with the fungicides and allowed to dry for an hour. A third lot of seeds received only *Azospirillum* inoculum and no fungicidal treatment.

After seed treatments, the seed samples were collected at random from the different treatments and the load of *Azospirillum* carried on the seed was estimated by the serial dilution plate technique using yeast extract glucose agar medium.

The treated seeds were sown in earthern pot (30 cm dia) containing unsterilized sandy loam garden soil. On 7th, 14th, 21st and 28th days after sowing, the population of the inoculated *Azospirillum* (S.3) was estimated in the rhizosphere[2] of the pearl millet plants using serial dilution plate technique. As strain S.3 was pink, the colonies were identified easily on agar medium The results are presented in table 1.

Treating pearl millet seeds with fungicides, viz , captan and thiram prior to *Azospirillum* inoculation did not significantly alter the population of *Azospirillum* on the seeds of the subsequent establishment of the inoculated *Azospirillum* in the rhizosphere region. On the other hand, treating the seeds with the above fungicides after seed bacterization adversely affected the number of *Azospirillum* cells on the seeds and also the subsequent establishment of the inoculated organism in the rhizosphere. The adverse effect of fungicides was reflected on the declining population of the inoculated organism even three weeks after sowing.

The reduction in the population of *Azospirillum* recorded with seeds treated with the fungicides after *Azospirillum* inoculation might possibly be due to the removal of *Azospirillum* cells from the seed surface due to fungicidal treatment. Fungicidal treatment of seeds already coated with bacterium will no doubt remove a sizable number of bacterial cells already adhering with the seeds and hence a reduction can normally be expected.

Seeds treated with the fungicides prior to *Azospirillum* inoculation did not record any significant reduction in the counts of *Azospirillum* and this confirms that the fungicides had no adverse effect

Table 1 *Effect of pearl millet seed treatment with fungicides on seed bacterization and the establishment of the inoculated Azospirillum in the rhizosphere region*

Treatment	No. of *Azospirillum* cells on the seed ($\times 10^2$)	*Population of the inoculated *Azospirillum* in the rhizosphere ($\times 10^4$)			
		7th day	14th day	21st day	28th day
Captan treatment (4 g/kg of seed) followed by *Azospirillum* inoculation	42.2	3.9	84.2	176.7	338.0
Azospirillum inoculation followed by captan treatment (4 g/kg of seed)	17.0	1.9	50.5	148.0	314.0
Thiram treatment (4 g/kg of seed) followed by *Azospirillum* inoculation	38.0	3.6	76.5	163.5	325.7
Azospirillum inoculation followed by thiram treatment (4 g/kg of seed)	11.0	1 0	36.2	124.2	269.5
Control (No fungicide; only *Azospirillum* inoculation	43.5	4.2	82.2	165.2	321.0
SED		0.25	4 00	5.30	17.42
CD		0.54	8.54	11.29	37 12

*Expressed g^{-1} of rhizosphere soil on dry weight basis.

on *Azospirillum* at the levels used. The method of treatment is mainly responsible for the reduction in the number of cells on the seeds. A reduction in the number of cells initially carried on the seeds might be one of the reasons for the reduced population of the inoculated *Azospirillum* in the rhizosphere region during early stages of the crop. However, in the case of captan, the adverse effect was alleviated within four weeks whereas with thiram, the effect persisted even after four weeks. The adverse effect of tetramethyl thiuram disulphids (TMTD) on *Azotobacter* was observed by Klincare[3] who had reported that wheat seed treatment with 50% TMTD ten days before bacterization delayed the development of *Azotobacter* in the rhizosphere.

The fungicides may also indirectly influence the subsequent establishment of *Azospirillum* in the rhizosphere by creating favourable or unfavourable conditions for the organism. Nayak and Rao[4] observed stimulation of N_2 fixation in soils by benomyl treatment (5 μg/g of soil) and concluded that the stimulation might be due to provision of a more favourable redox level. Bashan[5] enhanced wheat root colonization by *A. brasilense* by using substances inhibiting fungi and bacteria and not *A. brasilense*.

Increased populations of *Azospirillum* recorded in the rhizosphere of seeds treated with captan prior to *Azospirillum* treatment might be due to favourable shift in the ecological balance of the soil for *Azospirillum* or the chemical might have been utilized as energy source by the organism resulting in an increase[6].

These results indicate that the seed dressing fungicides like captan and thiram can be safely used at recommended doses (4 g/kg of seed) as a pretreatment prior to seed bacterization.

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COLCHICINE-INDUCED AMPHIDIPLOID OF *ATYLOSIA ALBICANS* × *ATYLOSIA CAJANIFOLIA*

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Atylosia albicans ($2n = 22$) and *Atylosia cajanifolia* ($2n = 22$) are the wild relatives of *Cajanus cajan* and possess high seed protein content[1]. *A. cajanifolia* is a drought-tolerent species[2], has forage potentiality in range land situations. F_1 hybrid seeds were obtained when pollination was done using *A. albicans* as seed parent and *A. cajanifolia* as pollen parent[3].

Seedlings of (*A. albicans* × *A. cajanifolia*) hybrid were treated with colchicine for inducing amphidiploidy. Forty-four somatic chromosomes were counted at metaphase (figure 6). The amphidiploid plant showed delayed flowering as compared to the diploid F_1 hybrid. Increase in the size of leaflets (figure 1), pollen (figures 2 and 3), stomata, flower and seed were noticed in the amphidiploid in comparison to F_1 hybrid plant. Dark green colour of leaves, reduction in pod size and pod set per cent were observed in the amphidiploid plant.

Meiosis in amphidiploid revealed $2n = 4x = 44$ chromosomes at MI. Twenty-two bivalents (figure 4) were recorded in 52% of the cells. Chromosome associations of 21 II's + 2 I's; 1 IV + 18 II's + 4 I's (figure 5) and 20 II's + 4 I's were recorded in 34, 8 and 6 per cent of the cells respectively. At anaphase-I, no meiotic irregularity was seen except in a few cells where lagging chromosomes were noticed, which resulted in the formation of micronuclei at sporad stage. Increased pollen fertility percentage (93.6) was noticed in the amphidiploid in contrast to 64 of the F_1 hybrid. Inspite of good pollen fertility, the seed setting was much lower in amphidiploid plant, as compared to F_1 hybrid.

In the present study, a majority of PMCs showed bivalents. Amphidiploid with higher bivalent frequency is reported[4] in the cross between *Phaseolus aureus* and *P. mungo*. The frequency of quadrivalent in the present amphidiploid was very low. Lower quadrivalent frequency has indicated that some kind of genetic mechanism evolved along with polyploidy to suppress multivalent formation to a considerable extent. The formation of univalents could be due to existence of some structural differences in the parental genomes.

As far as induced amphiploidy in *A. albicans* × *A. cajanifolia* is concerned, it has however not shown