availability of N, since the recovery of N from splitted dose remained higher than the whole dose of N applied at planting (Sharma *et al.* (1975).

It appears that N influences tuber yield mainly due to increase in tuber number/stem, since there was no significant difference in the stem number/plant. N is able to affect the stem number (Hay and Walker, 1989). Application of two-thirds of the recommended dose of N at tuber initiation (T_3) increased the tuber number significantly compared with basal (T_1) or one-third top-dressed at tuber initiation (T_2). As there was no significant difference in the stolon number amongst these 3 treatments, higher tuber number in T_3 could be attributed to more efficient conversion of stolon tips into tubers. The results indicated that application of 50 kg N/ha as basal dose is sufficient to build up early vegetative growth and produce good number of stolons. Application of 100 kg N/ha as top-dressing at the time of tuber initiation helps maintain fairly large foliage growth and convert maximum number of stolon tips into tubers, owing to better availability of N for a longer time. Dry-matter content of tubers did not differ among the treatments except in T_7 where it was low due to reduced and delayed application of split dose. Tuber-dry matter is less affected by applied N (Harris, 1987).

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Response of azolla (*Azolla pinnata*) to rice (*Oryza sativa*) herbicides

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Beneficial effects of dual culture of azolla in rice (*Oryza sativa* L.) fields have been well documented. However, inoculation period of azolla coincides with pre-emergence (pre-em) herbicide application time. Hence investigation was taken up to study the effect of promising rice herbicides on biomass production of azolla and to

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optimize the time interval to be given between herbicide application and azolla incoulation.

A field experiment was conducted during 1986--87 to study the response of the commonly used rice herbicides and to optimize the time interval to be given between herbicide application and azolla inoculation. The treatments were laid out in factorial randomized block design with 3 replications. The plot size was 1 m × 1 m. Azolla was inoculated @ 200 g/m^2 on the same, third day and sixth day after herbicide application as per treatment schedules. The details of herbicide used are given in Table 1. Superphosphate @ 8.0 g/m^2 and carbofuran (Furadon) @ 3.0 g/m^2 were applied on seventh day of azolla inoculation. The entire biomass from the plots were collected on 15 days after draining water completely. Nitrogen estimation on fresh-weight basis was also done.

Azolla biomass and relative growth rate were reduced significantly by herbicide application (Table 1). The highest biomass was recorded in the control. Percentage reduction in biomass was the least with application of EPTC (S-ethyl dipropyl thiocarbamate) either alone or in combination with 2, 4-D esters (21.0–23.6%). Butachlor was highly toxic to azolla, resulting in 65.0% reduction of biomass compared with the control. Jania and Moody (1981 and 1986) reported deleterious effect of herbicides on biomass production of azolla. The highest relative growth rate was recorded in the control, which did not vary significantly from EPTC applied alone or in combination with 2, 4-D esters. Butachlor resulted in the lowest growth rate of 0.1774 g/g/days. Nitrogen content of azolla was not influenced by any of the herbicide treatments. However, had azolla been incorporated after 15 days, there

Table 1. Response of azolla to herbicides and time of inoculation

Herbicide	Dose (kg/ha)	Biomass(after 15 days) # (tonnes/ha)	RGR # (g/g/ha)	N content # (%)
Molinate	2.88	4.86 a	0.2095 bc	2.5 a
EPTC	2.88	6.69 a	0.2337 bc	2.4 a
EPTC +2, 4-D EE	1.12 + 0.56	6.47 ab	0.2313 a	2.7 a
Molinate + 2, 4-D EE	1.80 + 0.56	5.20 ab	0.21.43 b	2.6 a
EPTC + 2, 4-D BE	1.12 + 0.56	6.50 a	0.2275 b	2.6 a
Thiobencarb	1.50	4.05 bc	0.1931 c	2.5 a
Butachlor	1.50	2.96 c	0.1774 c	2.4 a
Control	-	8.47 a	0.2467 a	2.6 a
Azolla inoculation time (days after herbicide application)				
	0	3.71 b	0.1882 b	2.7 a
	3	6.39 a	0.2277 a	2.6 a
	6	5.65 a	0.2214 a	2.7 a

EE, Ethyl ester; BE, butyl ester

In a column, any 2 means followed by any 1 common letter are not significantly different form each other at 5% level by LSD

would have been marked variations in the amount of N contributed because of significant variations in biomass production.

Among the time intervals studied, inoculation of azolla on third day after herbicide application resulted in the highest biomass (6.39 tonnes/ha) and relative growth rate. Significant reduction in these parameters was observed when azolla was inoculated on the day of herbicide application.

The interaction between herbicides and time of inoculation (data not furnished) revealed that the highest biomass was recorded with EPTC + 2,4-D ethyl ester followed by inoculation of azolla on third day after herbicide application.

It was concluded that EPTC either along or in combination with 2, 4-D esters may be used safely in azolla dual-cultured rice fields, provided a period of 3 to 6 days is allowed between herbicide application and azolla in culation.

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Herbicidal control of Johnson grass (*Sorghum halepense*)

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Control of Johnson grass [*Sorghum halepense* (L.) Pers.] is a problem, particularly in crops like sugarcane, maize and sorghum.

A field experiment was conducted at Navsari during 1989 and 1990 to test the efficacy of glyphosate and dalapon in the control of Johnson grass. Five treatments consisting of 2 levels of each herbicide, i.e. 0.92 and 1.38 kg a.i./ha of glyphosate and 5.00 and 8.50 kg a.i./ha of dalapon, along with control were laid out in randomized block design and replicated thrice. The seeds of Johnson grass were sown in 1.50 m × 1.50 m plot. The herbicides were applied 1, 2 and 3 months after sowing (March–May). The data on shoot- and root (0.25 m soil depth)-dry weight from area were recorded 1 month herbicide application at each 3 stages.

Herbicides significantly reduced the dry weight of shoot at all the 3 stages of application compared with the control