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The Effect of Salicylic Acid and Acetyl Salicylic Acid on Growth and Yield of Home Guard under Cool Greenhouse Conditions

Syed Karrar Haider[1] and Saifullah[2]
[1]Potato Research Station Abbottabad, Pakistan
[2]Department of Plant Pathology NWFP Agricultural University Peshawar, Pakistan

Abstract: Two concentrations of both Salicylic acid (SA) and Acetyl Salicylic acid (ASA) were used to investigate their effect on the growth and yield of potato cv. Home Guard under cool glass house conditions. ASA and SA applications induced toxic effects and negligible agronomic benefits were obtained.

Key words: Salicyclic acid, acetyle salicyclic acid, potatoes.

Introduction

Salicylic acid acts as an endogenous regulator of heat and odour production in thermogenic lilies and flower induction in *Lemna* species (Khurana and Maheshwari, 1978), *Impatients balsamina* (Nanda *et al.*, 1976), *Arabidopsis thialana* (Goto, 1981) and Oncidium (Hew, 1987). It also induces flower bud formation in tobacco tissue culture systems (Lee and Skoog, 1965). Salicylic acid and other phenolic compounds antagonized the growth inhibitory effects of ABA in radish seedlings (Ray, 1986) and *Amaranthus caudatus* seedlings (Ray and Laloraya, 1984). However, its combination with IAA at 0.1 mM stimulated adventitious root initiation in mung beans (Kling and Meyer, 1983). The present experiment was conducted to find out whether salicylic acid or acetyl salicylic acid have some effect on the growth and yield of potatoes.

Materials and Methods

Five treatments were compared comprising two concentrations (1 and 10 mM) each of the two chemicals plus control in which distilled water was applied to plants. The treatments were replicated six times and randomized within blocks. Within each block, two control pots were included.

Healthy and clean tubers of Home Guard in the sizes range 75-80 g were selected and counted from the lot which was grown as a seed crop at Frongoch Field Research Station in 1995. These tubers were placed in wooden trays and stored in a temperature controlled cabinet at 14°C constant temperature and provided with artificial strip lighting for 12 hours a day. The tubers were then planted singly in 17.5 cm plastic pots, with the tuber apex 8 cm below the rim and filled with standard growing medium (John Innes No. 2). The pots were transferred to an unheated glasshouse and irrigated daily from the top of the pots until the plants emerged. Therefore, plastic saucers under-neath- the pots were filled daily with water to the brim. The concentrations of SA and ASA plus water controls were applied regularly every week. Application was achieved by a hand-held sprayer with the aim of wetting plants to point to leaf run-off. During each spray the quantity of the solution applied was determined by subtracting the remaining solution from the total solution prepared. Approximately 55 ml of solution per pot was applied in the first three sprays whereas, at later growth stages, 150 ml of solution per pot was applied in the last three sprays.

Plant emergence was recorded once a week until emergence was complete. After harvesting, the samples were separated into roots, tubers, leaves and stems. The leaf area of a sub-sample was measured by a Delta-T leaf area meter. The number and weight of tuber <25 mm and >25 mm were recorded. Number of main stems, number of secondary stems and number of stolons were recorded. Subsequently, samples were dried in an oven at 80°C for 48 hours. After that, dry weights of tubers, roots, stems and leaves were recorded. A mean value for the two control pots per block was taken prior to two-way analysis of variance.

Results and Discussion

The higher concentration of both chemicals (10 mM) produced more main stems per plant than either the 1 mM or control treatments. The effects appeared to be especially pronounced in the case of ASA but the chemicals did not differ significantly at the same chemical concentration. The 1 mM concentrations did not differ from the control. The error variation was quite high for number of secondary stems per plant. None of the chemical treatments differed significantly from the control although there were some differences between the chemicals. Salicylic acid produced greater numbers than acetyl salicylic acid especially at the 1 mM concentration. The chemicals differed at the 1mM concentration with SA resulting in a significantly greater total number of stem per plant ($p<0.05$). In this experiment, approximately half of the stems comprised secondary stems although there appeared to be some differences between treatments. There was no significant effect on chemicals or their concentrations on number of stolons per plant. There were no significant effects of salicylic acid and acetyl salicylic acid or their concentrations on the number of tubers less than 25 mm per plant. Similarly, the fresh weight of tubers in this fraction was unaffected by treatments. Neither salicylic acid or acetyl salicylic acid affected significantly the tuber number greater than 25 mm. However, the higher concentration (10 mM) of both chemicals reduced significantly the tuber weight compared with the lower concentration (1 mM) and the untreated control (<0.001). The effect of the two chemicals was similar. The control and 1 mM did not differ significantly compared with the untreated control. The principal effect was a significant ($p<0.01$) reduction in tuber dry weight where a 10 mM concentration was applied. A similar effect was obtained with each chemical. Overall, this reduction was approximately 21 % when compared with the control treatment. The higher concentration of both SA and ASA reduced below-growing stem dry weight. The effect of the two chemicals was again very similar. The 0 and 1 mM treatments did not differ significantly. The only significant effect ($p<0.05$) was the reduction in the above ground stem dry weight per plant caused by the 10 mM concentration of SA. However, there was no significant difference between the 0 and 1 mM treatments. Again the principal effect here was a substantially reduced dry weight following application of 10 mM concentrations of each chemical. The effects of the chemicals were similar but ASA appeared to show a relatively larger reduction than SA when compared with the control and 1 mM treatments. Again, the 1 mM concentrations did not differ from the control. There was no treatment effect on specific leaf area. As for leaf weight, the effect observed was a marked reduction in leaf area when the 10 mM concentrations

Table 1: Effect of Salicylic Acid and Acetyl Salicylic Acid concentrations on growth and yield of potato

Concentration	0mM		1mM		10mM		SE	P-value
Parameters	SA	ASA	SA	ASA	SA	ASA		
No of main stems per plant	2	2	2	2	3	4	0.352	<0.01
No of sec. stems per plant	3	3	4	2	2	1	0.639	<0.05
Total No. of stems per plant	5	5	7	4	5	5	0.539	<0.05
No. of stolons per plant	22	22	27	24	25	30	2.527	ns
No. of tubers <25 mm per plant	15	15	18	18	14	17	2.819	ns
Fresh wt. (g) of tubers <25 mm per plant	40	40	35	44	42	43	7.446	ns
No. of tubers >25 mm per plant	8	8	7	9	8	8	0.525	ns
Tuber fresh weight >25 mm/plant	214	214	222	234	177	170	8.842	<0.001
Total No. of tuber per plant	23	23	25	26	22	25	2.751	ns
Total tubers fresh wt. (g) per plant	254	254	257	277	219	213	7.412	<0.001
Tubers dry wt. (g) per plant	58	58	57	64	46	45	2.147	<0.001
Below ground stem dry wt. (g)/plant	3	3	3	3	2	3	0.151	<0.001
Above ground stem dry wt. (g)/plant	2	2	2	2	1	1	0.117	<0.005
Total leaf dry wt. (g)/plant	6	6	6	7	5	5	0.159	<0.001
Specific leaf area (cm^2/g)	308	308	315	316	285	274	12.734	ns
Total leaf area (cm^2) per plant	1929	1929	1963	2095	1553	1467	93.165	<0.001
Tuber dry matter percentage	23	23	22	23	21	21	0.360	<0.001
Total dry wt. (g)/plant	69	69	68	76	55	54	2.262	<0.001
Harvest index	1	1	1	1	1	1	0.007	ns

were applied. The 1 mM treatments did not differ from the control. The higher concentration (10 mM) of both chemicals reduced the TDM % significantly ($p<0.01$). Again there were no differences between the 1 mM concentrations and the control. As might be expected from the previous dry weight measurements reported above, the only significant effect was a reduction in total dry weight in the 10 mM concentrations of each chemical when compared with the 1 mM and control treatments. The 10 mM SA treatment reduced dry weight by 20% compared with the control, whereas the same concentration of ASA resulted in a 21 % dry weight reduction. There were no significant effects of chemicals or their concentrations on harvest index (Table 1).

The principle effect on growth was reduction in total and component part dry-matter when either chemical was applied at the 10 mM concentration which could be due to leaf damage by the treatments resulting in decrease in dry matter accumulation (Davis and Klepper, 1980). 10 mM SA/ASA inhibited ethylene formation in pear cells growing in suspension culture while Cleland and Ajami (1974) concluded that 5.6 mM SA caused maximum flower induction in *Lemna gibba*. The 1 mM concentrations did not differ from the control for any measure of growth. No attempt is made here to make comparisons between the chemicals at different concentrations. However, the data indicate that the plant response to application of either chemical was similar.

Thus, the overall results indicate that the chemical applications induced toxic effects and little agronomic benefit was found. Davis and Klepper (1980) reported that foliar application of salicyclate derivatives to soyabean plants mostly killed the terminal bud and reduced the immediate growth which resulted in lateral axillaries. They further reported that ASA application increased the number of trifoliate leaves, pod number, seed number per plant and empty pods weight but not seed weight. The increase in seed number was associated with decrease in seed size. Manthe *et al*. (1992) used 1, 2, 3.5 mM SA and stated that these concentrations decreased shoot growth and fresh weight of *Vicia faba* compared with an untreated control.

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