CHEMICAL CONTROL OF PENNESETUM PURPUREUM—LABORATORY TRIALS

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Dichloral urea, diethyl chloracetamide, nitrourea, chloralhydrate, sodium trichloroacetate, sodium borate, ammonium thiocyanate, sodium arsenite, arsenic oxide-sulphuric acid mixture, sodium chlorate, maleic hydrazide and the salts containing inorganic ions Cu^{2+}, Co^{2+}, MoO_4^{2-} and Zn^{2+} were tested in experimental plots for their phytotoxic activity on a hybrid variety of Pennesetum purpureum. Sodium borate (2500 Kg/hectare), sodium arsenite (250 Kg/hectare) and sodium chlorate (1000 Kg/hectare) through soil and ammonium thiocyanate (100 Kg/hectare) through direct spray function as growth retardants. Arsenic oxide-sulphuric acid (100 : 300 Kg/hectare) spray kills the existing leaves. Sodium chlorate (250 Kg/hectare) spray exerts phytocidal action on young plants (3 weeks). Maleic hydrazide (50 Kg/hectare) exerts permanent growth suppressant action on older plants (height) $\geqslant$ 1 m) and kills the existing leaves of younger plants (height $\leqslant$ 0·5m). Copper sulphate (100 Kg/hectare) induces partial drying of existing leaves and cobalt sulphate in the same dose induces yellowing of leaves extending the period of growth beyond the season of maximum growth of the control. Ammonium molybdate and zinc acetate in the same dose do not exert any perceptible effect.

Elephant grass or Napier grass or Pennesetum purpureum is pernacious perennial weed growing extensively in eastern part of India. It grows very rapidly and forms forest like wild growth. Control of such weed in areas around shoulders of runways, vehicle and railway tracks, highways, airports, defence and industrial installations, communication lines, refineries, utility spots and other uncultivated land is very much desired because of the considerations of accessibility, visibility, fire prevention, land utilization and others. Literature survey[1] on the subject does not reveal any systematic work on the chemical control of the specific weed. With these facts in view several soil sterilants, weedicides and toxic ions have been tested for their phytotoxic action on the plants of Pusa giant hybrid Napier grass (P. Purpureum and P. typhoides) in experimental plots. Dichloral urea[2] diethyl-chloracetamide[3] nitrourea[4], chloral hydrate[5], sodium trichloroacetate[6], sodium borate, ammonium-thiocyanate[7], arsenic oxide-sulphuric acid[8], sodium chlorate[7], and maleic hydrazide[8] were used by suitable modes of application in concentrations in which these compounds are reported to be active against some other flora especially members of gramineae family. Maleic hydrazide and sodium chlorate proved to be promising agents to be used in actual operation as growth suppressant and phytocide respectively. Therefore these chemicals were subjected to detailed tests for their activity at different stages of plant growth and in combination with each other to ascertain the nature of response. As the essential ions are biphasic in their nature functioning as toxic agents at higher concentration, copper sulphate, cobalt sulphate, ammonium molybdate and zinc acetate were also screened for their phytotoxic action.

EXPERIMENTAL

The rooted slips and stems of the Pusa giant hybrid Napier grass (P. purpureum and P. typhoides) were planted in the last week of April 1970 in 1m×1m plots in the premises of this laboratory. Each plot contained 3 bunches of roots separated at a distance of about 0·2m. The compounds were applied either through the soil by uniformly sprinkling the powder or solution all over the plot or through leaves by uniformly spraying the solution or dispersion all over the plants. For the test of toxicity of compounds at pre-emergence stage, the compounds were sprinkled over a plot having stems and roots left over from freshly cut plants. The initial testing was done mostly at the time of plant height of 1 m. The treated plants were observed daily for first week and then weekly for 5 weeks. Further observations were discontinued if no effect was observed during this period. If any significant observation was made, it was continued up to the season of flowering (first week of October 1970). The details of the application of individual compounds and their effects are given below.

Dichloral urea : 2·0 g of the compound dispersed in 1 l. of water containing 2·0 g of sodium lauryl sulphate was applied through soil. The compound did not exert any apparent effect.

Diethyl chloracetamide : 2·0 g of the compound dispersed in 1 l. of water containing 2·0 g of sodium lauryl sulphate was applied through soil. The compound did not exert any apparent effect.

Nitrourea : 2·0 g of the compound dispersed in 1 l. of water containing 2·0 g of sodium lauryl sulphate was applied partly through soil and partly sprayed on 10 plants. The compound did not exert any apparent effect.

Chloral hydrate : 10·0 g of the compound dissolved in 0·5 l. of water was used for testing the toxicity at pre-emergence stage. The growth of sprouts from the stems was similar to that from the control. Therefore the compound is ineffective as pre-emergence phytotoxic agent.

Sodium trichloroacetate : 5·0 g of the compound dissolved in 0·5 l. of water was applied through soil. The compound did not exert any apparent effect. The same concentration of the compound was used for its pre-emergence phytotoxic action. The density of sprouts from treated stems was significantly less than that of the control. After 3 weeks of the application tips of the leaves exhibited dry appearance but after 6 weeks the growth was found to be normal. Therefore the compound possesses slight pre-emergence phytotoxicity at this dose of application.

Sodium borate : 250 g of finely powdered compound was uniformly sprinkled over soil of a plot having plants of height 1·5 m. The following observations were made at given intervals.

1 day — White streaks and patches over leaves.

3 weeks — Tips of leaves presented dry appearance which increased for some time.

6 weeks — Plants appeared to be reviving.

7 weeks — Only tip of leaves were dry.

10 weeks—Plants were completely healthy and normal.

During this period as well as afterwards the rate of growth of the plants was less than that of control. Flowering was also normal at the same time as with the control. Therefore the compound exerts phytotoxic action as a growth retardant.

Ammonium thiocyanate : 10 g of the compound was dissolved in 1 l. of water and sprayed uniformly over plants at given intervals.

2 days — White patches over most of the leaves. The upper leaves were more affected.

2 weeks— White patches became pale and dry.

4 weeks— With new grown leaves, plants became almost normal.

5 weeks— The plants became normal.

During this period as well as afterwards the rate of growth of plants was less than that of the control. Flowering was normal at the same time as with the control. Therefore the compound exerts phytotoxic action as a growth retardant.

Sodium arsenite : 25 g of the compound was dissolved in 0·5. l of water and applied through soil. The following observations were made at the given intervals.

1 day —White streaks and patches over leaves.

4 days —Almost half of the number of leaves became yellow and dry with crumbling. This effect increased with time. Some leaves were quite normal.

4 weeks—Dry leaves developed good number of black spots. A few stems dried completely. In several other cases lower leaves were dry whilst new leaves remained unaffected.

6 weeks—The plants appeared to be reviving.

8 weeks—The plants were reviving.

10 weeks—The plants were completely healthy and normal.

The rate of growth of the plants was less than that of the control during 6 weeks after application. After this period the rate was almost the same as that of control. Therefore the compound exerts phytotoxic action as temporary growth retardant.

Arsenic oxide sulphuric acid combination : 10 g of arsenic oxide was heated with 100 g of 30% sulphuric acid until it was dissolved. The solution was diluted to 1 l. and sprayed uniformly on to plants of height 2 m. The following observations were made at given interval.

2 hrs. —Almost all leaves and stems turned completely muddy in colour and the remaining ones developed such patches.

1 day —The leaves were drying.

2 weeks—All old leaves have dried. New leaves emerging at nodes after application were normal and healthy. Several of these were found to be partly wrapped inside dried leaves.

3 weeks—New leaves were normal. Height of the plants remained static. 5·0 g of maleic hydrazide as diethanol amine salt in 0·5 l. water was sprayed on to plants.

5 weeks—The leaves have developed red colour and height remains static.

15 weeks—No new emergence of leaves. Height remained static.

Thus Arsenic oxide-sulphuric acid combination is capable of killing all foliage existing at the time of application. But the application leads to new emergence of leaves at the node, which is not observed in the control. The development of new emerging leaves can be controlled by application of maleic hydrazide.

Sodium chlorate : 100 g of the compound dissolved in 0·5 l. of water was applied through soil. The following observations were made at the given interval.

1 day —White streaks and patches over most of the leaves.

3 days —Most of the leaves became yellow and dry and were crumbled.

3 weeks—Dessication of leaves was on an increase.

5 weeks—Most of the new emerging leaves were not normal and had red and yellow spots. Growth of plants in height almost static upto this period.

9 weeks—Plants were not as healthy as control but continue growing in height. Some of the plants died.

Flowering occurred at the same time as with control. Therefore, the compound exerts phytotoxic action as a growth retardant. It does not exert general phytocidal action at this concentration in soil.

The effect of the application of 10 g of the compound through soil was less severe. The effect was visible in 3 weeks as general fading of green colour of the foliage accompanied by partial yellowing with tiny red spots almost all over. The effect increased for some time. But new emerging leaves were only slightly affected and in 9 weeks, the plant appeared to be almost normal. The same dose was applied at pre-emergence stage. The following observations were made at the given intervals.

2 weeks—New emerging leaves not healthy.

3 weeks—Lower leaves were dry and new emerging leaves normal.

5 weeks—The plant had overcome the toxic effect.

Therefore the phytotoxic influence at this concentration in pre-emergence application is temporary.

25 g of the compound dissolved in 0·5 l. of water was sprayed on the plants of height 0·6 m and of age 3 weeks. The following observations were made at the given intervals.

1 day —The leaves have mostly become white.

2 days —Dessication of leaves has started from their outer periphery.

2 weeks—Most of the leaves were completely dessicated.

3 weeks—All leaves and some stems were completely dessicated.

4 weeks—Remaining stems were in the process of dessication.

5 weeks—The leaves and stems were dead.

The application of lesser dosage of the chemical on greater age group of plants leads only to dessication of leaves and the plants overcome the toxic influence after sometime. The toxic effect decreases with decrease in dosage of application and increase in plant height. Therefore the compound exerts phytocidal effect at the concentration of 25 g/m^2 (=250 Kg /hectare) when sprayed on to plants of 3-week age.

Maleic hydrazide : 5·0 g of the compound and 5·0 g of diethanolamine were intimately mixed and dissolved in 0·5.1 of water. The solution was sprayed at different periods on to the plants of different plots having plant heights of 1·0, 1·5, 2·0 and 2·5 m respectively. After the application, the heights of the plants

became static. The leaves developed red colouration in 3 weeks in all the cases. With time the colour increased and the green colour darkened. The darkening of green colour was much more significant with plants of height 1·0 m. The effect was successively less with increase in the height of the plants such that with plants of height 2·0 and 2·5 m the effect was not significant. The red colouration was presumably due to anthocyanin formation and the darkening of green colour, to increased rate of formation of chlorophyll as has been observed by the application of the compound on some other flora [9,10,11] with darkening of green colour the leaves also became brittle. After 7 weeks of the application of the compound in each case, new leaves emerged at the nodes. The emerging leaves were narrow as compared with normal emerging leaves in the control. The compound is known to exert phytotoxic action in introducing growth abnormalities.

The treated plants of height $\geqslant 1 \cdot 5$ m exhibited late flowering. The delay was about 4 weeks. The treated plants of height 1·0 m did not flower as observed upto 9 weeks after normal flowering time (first week of October). All the plants were cut at the same time (first week of December). The stems of the treated plants of height 1·0 m did not sprout and they finally dried up. The sprouting in the stem of those $\geqslant 1 \cdot 5$ m was significantly less than in the control. The stems of all the plants remained green.

Similar application of the compound to the plants of 0·5 m height resulted in appearance of red colour in 2 weeks. After 6 weeks the dessication of leaves started. Ultimately all foliage was dessicated but not the stems. In order to investigate the translocation mechanism of the phytotoxic action of the compound, plants of height 1·5 m were sprayed with the same concentration of the compound upto 1·0 m from the ground. Observations similar to that of the plants of 1·5 m height, which were given spray all over, were recorded.

Therefore the compound exerts translocated phytotoxic action as a permanent growth suppressant for plants of all age groups. The toxic action is more pronounced with younger plants.

As maleic hydrazide suppresses the growth and sodium chlorate kills the existing leaves, a mixture of the two was considered to possess greater toxic potency. With this idea plants of height 0·5 m were sprayed with a mixture of 5 g of maleic hydrazide as diethanol amine salt and 25 g of sodium chlorate. Within 3 weeks the plants were completely killed. Thus the response to the mixture is synergistic as the phytocidal action is rapid.

Metal ions : 10 g of copper sulphate, cobalt sulphate, zinc acetate and ammonium molybdate dissolved in 0·5 l. of water were sprayed on to different plots having plants of height of 0·75 m. Copper sulphate induces partial drying of leaves. Cobalt sulphate induces yellowing of all the leaves. The test was conducted at a time just preceeding flowering time when further growth in height of all plants, whether big or small, stops. The plants treated with cobalt sulphate continued to grow in height (upto 1·15 m) for a longer period even after the growth of the control (upto 0·85 m) stopped. Zinc acetate and ammonium vanadate do not produce any visible effect.

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