STUDIES ON THE EFFICACY OF SOME HERBICIDES ON THE CONTROL OF WEEDS IN JAPANESE MINT*

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ABSTRACT

The present investigation was aimed to evaluate the effectiveness of nine herbicides in the control of weeds associated with Japanese mint (*Mentha arvensis*) crop. The chemical method of weed control used in this investigation was found to be very effective in preventing weed growth in the mint crop. As a result of herbicidal treatment, the weeds underwent a marked reduction in their dry matter accumulation, coupled with a significant increase in the yield of mint herb and mint oil.

Of the different herbicides embutox plus applied as post-emergence treatment and tok E-25 applied in the pre-emergence stage were found to be effective weed-killers, contributing a significant increase in mint foliage and oil yields. Telvar was similarly effective on application at the post-emergence stage. Other herbicides, *viz.*, 2, 4-D and bladex-O also yielded useful responses.

INTRODUCTION

CONTROLLING weeds in the fields of Japanese mint (*Mentha arvensis* Linn. subsp. *haplocalyx* Briquet var. *piperascens* Holmes.) has not taken recourse to yet in India by chemicals/herbicides and scarce literature is available in this line. Only the work of Gulati and Bhan (1972) carried out under Tarai (U.P.) conditions is available. It was mentioned therein that if the fields were not infested with *Cyperus rotundus* and *Cynodon dactylon*, simazine at 1·0–1·5 kg. (a.i.) per hectare, when sprayed at pre-emergence, controlled weeds effectively. Although some work has been done towards the control of weeds infesting mint crop at abroad (Finney, 1947; Guenther, 1961;

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Rossberg, 1964 and others), it was considered essential to screen out a few herbicides in this region where cultivation of Japanese mint has very recently started in a big way. Results of the studies are reported in this paper.

Experimental Procedure

The experiments were conducted at the Research Station, Banthra of the National Botanic Gardens, Lucknow, during the years 1966 and 1967. Banthra is situated at an altitude of 115 metres M.S.L. The soil of the experimental field was silty clay loam with an average pH of 8·4. It was low in organic carbon, available phosphorus and total nitrogen and with high available potash. The conductivity of the soil was normal.

Mentha arvensis L. subsp. *haplocalyx* Briquet var. *piperascens* Holmes commonly known as Japanese mint was obtained from the Research Station itself where it was introduced. The crop was raised as described by Chopra and Kapoor (1967).

The herbicides included in the present studies are given below.—

Chemical name of the herbicides	Common name	Doses (Kg/ha)		
		Low	Medium	High
1. 2, 4-dichlorophenoxyacetic acid	2, 4-D	0·5	0·75	1·0
2. 2, 4-dichlorophenyl 4-nitrophenyl ether	tok E-25	2·0	4·0	6·0
3. 3-(*p*-chlorophenyl) 1, 1-dimethylurea	telvar	2·0	4·0	6·0
4. 2, 3, 6-trichlorobenzoic acid	TBA	0·5	0·75	1·0
5. 2-methyl-4-chlorophenoxy acetic acid	MCPA	1·0	2·0	3·0
6. 3-amino 1, 2, 4-triazole	bladex-0	2·5	5·0	7·5
7. 4 (4-chloro-2-methlyphenoxy) butyric acid	tropotox	1·0	1·5	2·0
8. 2, 4-dichlorophenoxybutyric acid	embutox	1·0	1·5	2·0
9. 2, 4-dichlorophenoxybutyric acid and 4-chloro-2-methyl phenoxyacetic acid	embutox plus	1·5	2·0	3·0

About 37 species of weeds, both grassy and non-grassy, were recorded to be growing in the field where Japanese mint was under cultivation (Misra *et al.*, 1973 *a*). The most common ones were: *Cyperus rotundus* L. (55%) *Cynodon dactylon* pers. (20%), *Chenopodium album* Linn. (8%), *Asphodelus tenuifolius* Cav. (6%), *Trianthema portulacastrum* Linn. (5%) and miscellaneous species (6%). The weather conditions during the crop season of 1967 are given in Fig. 1. The experiment was a factorial type and was laid out in a split plot design with 3 replications. For comparison of the above treatments a contiguous 9 untreated plots were also laid out.

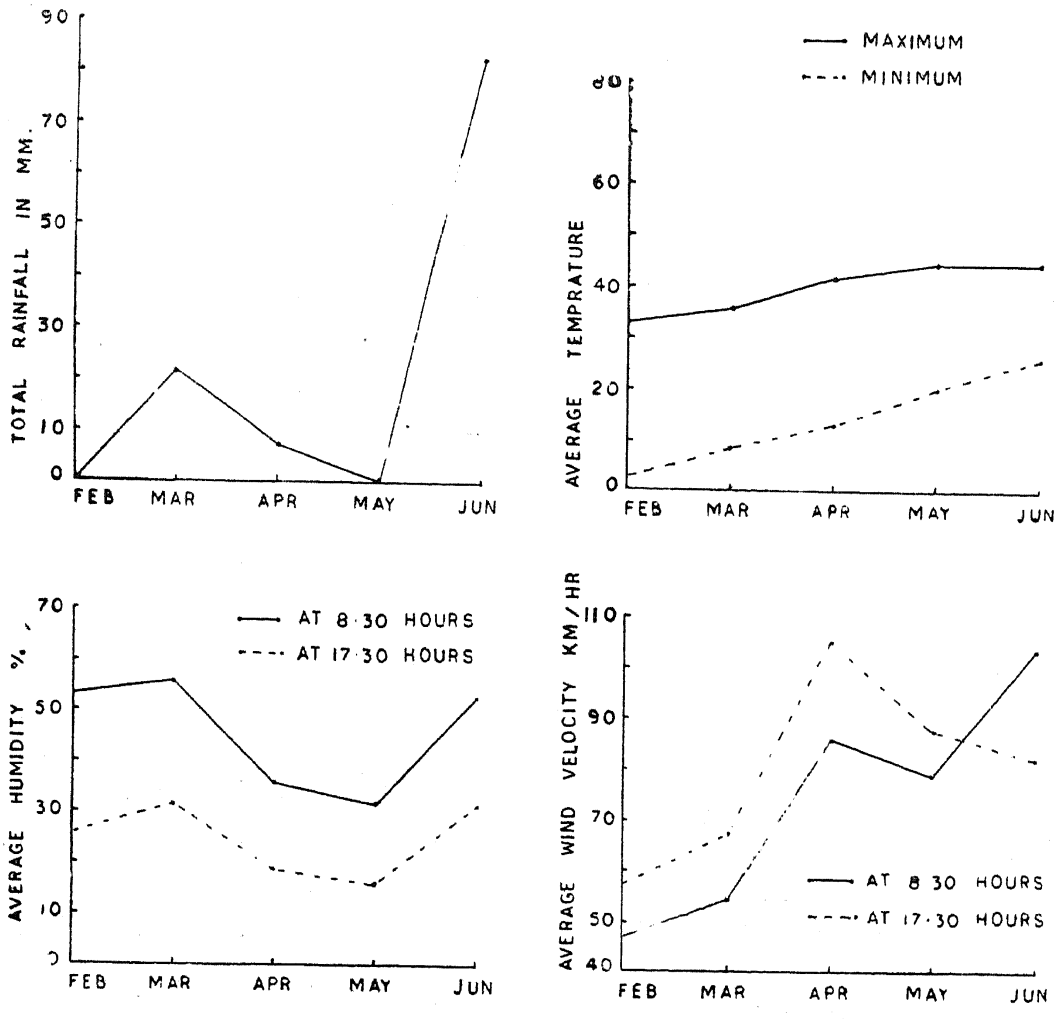

FIG. 1. Weather records from January to June 1967 during the period of Japanese mint crop season.

The effectiveness of the heribicides in each case was determined in terms of fresh weight production of mint herb and their oil content. After taking

the fresh weight record of each of the treated series, the samples were properly dried in shade. For the purpose of oil content, the air dried herb was distilled in an ordinary distillation apparatus. Weed control was measured in the form of dry matter produced by them at the harvest of the mint crop. However, the fresh weight of mint, its oil content and dry matter accumulation by weeds were recorded on hectare basis.

Results

The data on the fresh mint herb, crude oil content and dry weight of the total weeds of the experimental plots and control are given in Tables I, II and III.

Effect on mint herb.—The herbicide embutox plus showed highest yield of herb (73·249 q/ha) and the lowest figure (4·633 q/ha) was seen in the series treated with embutox herbicide. Embutox plus showed the highest value followed by tok E–25, whereas minimum yield was recorded in embutox treated series. Stage of weedicide application also showed significant results in herbage production. Out of all the herbicides tok E–25 and telvar gave highest production of Japanese mint herb applied at the pre-emergence stage. Though the highest mint yield was obtained in the post-emergence stage of application yet the minimum figures were observed at the 15 days after post-emergence sprayings. In some cases, the high rate of application of herbicides was found affecting adversely the development of mint crop.

Effect on oil content.—On scanning the data presented in Table II, incorporating the crude Japanese mint oil obtained on distillation of the herb showed similar trend of response as earlier observed in the case of green herb. The herbicide which was found to increase the fresh weight of mint herb was also increasing the mint oil simultaneously.

Effect on the dry weight of the weeds.—Dry matter produced by weeds in the plots treated with different herbicides is presented in Table III. The herbicide tok E-25 was seen most effective in reducing the dry matter accumulation of weeds significantly than any other herbicide, however, 2, 4–D and embutox plus at high dosage concentration applied at post-emergence stage also reduced the dry weight of the weeds. High values of dry weight were seen at the lower dosage spraying of herbicides particularly at the pre-emergence stage. It was invariably seen that the herbicides effectively found reducing the dry weight of weeds were also found helpful in increasing the green herb production of mint resulting in more oil yield.

TABLE I

Effect of herbicides on the green herb of the Japanese mint (q/ha)

Herbicides	Pre-emergence			Post-emergence			15 days after post-emergence		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2, 4-D	7·333	35·133	54·016	6·349	48·133	65·249	9·099	34·583	37·933
Tok E-25	13·883	47·083	67·166	48·299	71·599	50·966	35·083	35·749	34·666
Telvar	12·933	41·183	65·016	39·466	62·333	49·849	37·749	34·549	14·916
TBA	14·266	34·433	36·016	12·633	35·416	36·549	13·333	32·766	15·166
MCPA	12·249	33·383	34·799	15·606	48·266	50·416	14·666	35·933	36·266
Bladex O	6·133	36·509	37·083	5·583	63·816	63·999	6·849	37·133	49·266
Tropotox	7·916	13·383	19·099	11·499	45·333	54·849	6·249	36·183	46·599
Embutox	7·683	26·766	30·599	12·599	48·599	51·716	4·633	38·383	36·083
Embutox plus	22·499	29·833	32·249	30·499	54·999	73·249	23·749	36·133	40·833
Control	4·033	5·249	4·749	5·416	4·833	4·166	3·749	6·083	5·833

S.Em. ± 0·349 q/ha.
C.D. at 5% = 0·739 q/ha.
C.D. at 5% for concentration = 1·241 q/ha.
C.D. at 5% for stage of application = 1·045 q/ha.

TABLE II

Yield of Japanese mint oil following the application of different herbicides (kg/ha)

Herbicides	Pre-emergence			Post-emergence			15 days after post-emergence		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2, 4-D	2·193	10·533	16·199	1·899	14·433	19·566	2·727	10·372	11·377
Tok E-25	4·159	14·117	20·143	14·488	21·477	15·288	10·517	10·717	10·388
Telvar	3·877	11·799	19·505	11·838	18·693	14·949	10·209	10·359	4·467
TBA	4·277	10·327	10·805	3·788	10·017	10·959	3·993	9·827	4·543
MCPA	3·672	10·017	10·438	4·693	14·477	15·117	4·393	10·722	10·877
Bladex O	1·833	10·977	11·117	1·666	19·138	19·193	2·049	11·133	14·777
Tropotox	2·372	4·009	5·727	3·443	13·593	16·455	1·872	10·855	13·993
Embutox	2·305	8·027	9·183	3·783	14·583	15·157	1·383	11·509	10·822
Embutox plus	7·443	8·888	9·672	9·149	16·493	21·909	7·122	10·838	12·243
Control	1·199	1·566	1·416	1·616	1·449	1·249	1·116	1·816	1·749

S.Em. ± 0·445 kg/ha.
C.D. at 5% = 0·943 kg/ha.
C.D. at 5% for concentration = 1·969 kg/ha.
C.D. at 5% for stage of application = 1·593 kg/ha.

TABLE III

Effect of herbicides on the dry matter production of weeds (q/ha)

Herbicides	Pre-emergence			Post-emergence			15 days after post-emergence		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2, 4-D	15·959	7·945	5·174	15·929	8·110	4·923	15·907	8·666	5·354
Tok E-25	15·122	6·859	3·608	8·040	3·454	3·469	8·358	8·220	5·631
Telvar	14·645	7·909	4·875	8·138	6·449	6·879	8·280	8·479	10·224
TBA	13·799	9·982	7·674	13·979	9·284	6·979	14·742	8·120	12·243
MCPA	14·248	14·315	8·827	14·180	14·459	7·160	14·531	13·941	8·237
Bladex O	15·276	7·009	7·133	15·418	5·792	5·085	15·394	7·692	7·005
Tropotox	15·149	15·174	13·609	14·737	7·027	5·214	15·647	7·277	6·920
Embutox	15·319	11·707	8·452	14·154	6·646	5·232	15·632	6·723	8·995
Embutox plus	11·153	7·933	11·704	10·005	5·554	4·388	10·433	8·380	7·653
Control	15·753	16·340	16·421	15·728	15·763	15·775	15·825	15·978	16·056

S.Em. ± 0·034 q/ha.
C.D. at 5% = 0·072 q/ha.
C.D. at 5% for concentration = 0·165 q/ha.
C.D. at 5% for stage of application = 0·094 q/ha.

Discussion

On the basis of the present investigation, it seems obvious that marked improvement in the yield of mint crop can be effected through suppression of associated weeds by using herbicides. It is of interest to note that all the nine different herbicides used in these experiments are not identically effective in the control of weeds. Some are highly potent in relatively low dosage concentration, others need heavier one to obtain similar results.

It is true that some herbicides effectively control the growth of weeds when applied at the pre-emergence stage, likewise other herbicides kill the weeds on application at post-emergence stages as also when applied at a fortnight later. It, however, remains to be seen as to which of these treatments were, contrariwise, beneficial to mint crop. Observations show that the delayed treatments like the ones made a fortnight after post-emergence stage are not much helpful to the successful production of mint crop. The critical period when the crop grows abundantly is already over and it becomes difficult to make good the losses (Misra *et. al.*, 1972). In general, however, post-emergence treatments are more effective and more beneficial to mint production. Perhaps they permeate into the seeds and tubers of weeds and act on the young foliage subsequently (Misra, 1971).

Among the 9 herbicides used in this investigation tok E–25 and telvar were highly effective in weed suppression when applied at pre-emergence stage, while embutox plus was effective on post-emergence stage. A combination of treatments of 2, 4–DB and MCPA made at the post-emergence stage had a very effective and synergistic action, which has resulted in complete suppression of weeds increasing the mint yield to 73·249 q/ha.

A survey of results obtained on the treatment of soil (pre-emergence) planted with mint by certain herbicides show that 2, 4–D, tok E–25, telvar and TBA were observed to increase mint herb and mint oil and decreased the dry matter accumulation of weeds. Similar results were obtained by Baldwin and Furtig (1963) by isocil, trifluralin, bromacil and diuron herbicides applied at pre-emergence stage of mint crop. It is found that larger density of occurrence of weeds rested only with the few weed species and of these nutgrass (*Cyperus rotundus* L.) occupied the predominant place. Therefore, only those herbicides which had a potent effect on the suppression of nutgrass (Misra *et al.*, 1973 *b*) were the ones found to increase the production of mint crop by reducing the dry matter accumulation of weeds.

The post-emergence treatment of herbicides gave better reponse than the other stages of the application in increasing the mint herb and mint oil. Guenther (1961) has also reported similar results with diuron. Embutox plus herbicide was seen most effective for this purpose. In the recent past the use of the mixture of herbicides proved to be more effective than their individual formulations for the control of weeds in different crops (Gill *et al.*, 1970; Green, 1963; Singh and Chowdhury, 1970; Narayanan and Meenakshisundaram, 1957). The weedicide tok E–25 at medium dosage concentration was found beneficial. But increasing the doses, more pronounced effects on the dry matter accumulation of weeds were obtained. It, however, caused damage to the mint crop. Re Glannetto (1964) has also observed a good control of broad-leaved weeds in mint crop by the use of tok E–25.

The application of herbicides made 15 days after post-emergence does not show much advantage in increasing the herbage and oil yield of mint and in reducing the dry matter of weeds. Of course, some of the herbicides used were effective in reducing the dry matter accumulation but were not instrumental in increasing the herbage yield of the mint.

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