Biodynamic approaches to demote the allelopathic effects of Parthenium hysterophorus

R. Balakrishnaraja, V. N. Logesh, V. Dhananjeyan, S. K. Dhinesh Kannan

ABSTRACT--- Parthenium hysterophorus is an invasive weed sheltered in and around agronomic and barren lands. The Plant was recognized to exert its allelopathic activity towards the adjacent plants which influences poor seed sprouting, reproduction and dwarf plants etc. resulting in poor yield. In Hominids, these allergens cause Asthma, Dermatitis and bitter milk disease in livestock. This study was designed at overpowering the allelopathy of this plant allergens and swaying the growth, reproduction and seed development of the affected plants. Currently open chemical control systems tend to adulterate the terrestrial and the biota. While the Biological control methods were hard for the agrarians to procure in regular practice. This method was a simplified procedure dealing with the identification of decoctions from accessible farming capitals such as plant extracts and cattle excretions etc. to detoxify the allelopathic compounds of this hostile plant.

Keywords: Parthenium hysterophorus, Allelopathy, Cattle excretions and Plant extracts.

I. INTRODUCTION

This extra-terrestrial weed *Parthenium hysterophorus* was supposed to be introduced in India as pollutants through the PL 480 wheat (In 1954, Public Law 480 excelled to offer food grains to the emerging nations to abolish famine and malnourishment) received from the USA during the food crisis in the 1950s. *Parthenium hysterophorus* of Asteraceae family was a productive weed, generating millennials of tiny snowy capitula which individually produces at least five seeds in average on their adulthood.

A lone plant could yield more than ten thousand potent seeds and these seeds would diffuse then propagate to shelter outsized zones because of its great fecundity. It is one of the most shattering and lethal plant in the world[1] . The output of silage was reduced by 90% in its presence marking the fields sterile and evading the eminence of terrestrial dependents and their wellbeing thereby affecting the quality meat milk and vegetative output.[2] It is a deliberate menace to the bionetwork due to its rate of invasion and allelopathy, having the potential to substitute inherent flora[3]. It discharges phytotoxins to its neighboring's from its fetid biomass and root through the earth. The major sesquiterpene lactone in parthenium had been recognized as Parthenin along with ambrosin of contented 8 % and 5 % of the arid mass of flowers and leaves correspondingly. Inference was made that parthenin was existing in diverse plant parts, predominantly in the trichrome on leaves and stems based on human allergic reactions after skin communication with parthenium plants. Parthenin has been concerned as an imperative phytotoxic in allelopathy[4].

In perennial crop zones, Glyphosate had been applied recurrently in the untilled grounds of Caribbean Islands since ages to cope the effects of the weed and its supplementary bothersome plants. Agronomists have lately witnessed with single or multiple glyphosate claims of abridged parthenium control[5].

Various plants were testified to own co-inhibition property and struggles had remained to practice them in herbicides regulation. Antagonistic displacement of parthenium weed will possibly be attained by implanting *Cassia sp.* alike *C. sericea, C. tora, A. spinosus* and other in the likes of *T. purpurea, H. suaveolens, S. spinosa,* and *M. jalapa* etc. are proficient of commendably overpowering parthenium at their locales[6].

At this juncture, the idea is to exploit the extracts of the plants with allelopathic potential counter to the noxious phytochemicals of parthenium and application over the pretentious plants enabling seed germination and active progress in them.

II. MATERIAL AND METHODS:

A. Plant Materials:

Garden-fresh *Parthenium hysterophorus* plants from the fields of Bannari Amman institute of technology, Sathyamangalam, Erode were uprooted and used for this study. The plant resources were hewed and air dried for a week. Then the plant material was ground and powdered encompassing all the portions of the plant such as root, shoot, leaves and flowers.

Field study was done to recognize floras with allelopathic prospective to counter the phytochemicals of *Parthenium hysterophorus*. The plants acknowledged were *Calotropis gigantea, Acacia concinna, Mangifera indica and Cassia tora.*

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Then the plant *Calotropis gigantea* from the fields of Bannari Amman institute of technology, Sathyamangalam, Erode were utilized. The plant materials were chopped and air dried for a week. The plant material was ground to powder. The powder samples of *Acacia concinna and Cassia tora* were procured from the Universal good life center, Coimbatore.

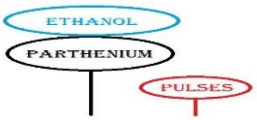
The urine and dung of kangayam breed cow *(Bos indicus)* and Jersey *(Bos taurus)* were obtained in a sterile container from Bannari Amman dairy farms, Sathyamangalam, Erode and refrigerated at 4°C. Paper cups and pulses such as *Vigna unguiculata* and *Vigna radiata* were procured from Bannari Amman Agro shop, Sathyamangalam, Erode.

B. Sample Extraction:

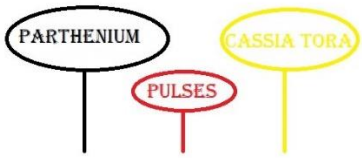
Grinded powder samples 25mg *(Parthenium hysterophorus, Calotropis gigantea, Acacia concinna, and Mangifera indica, Cassia tora)* were exposed to maceration individually for a period of 5 days with ethanol (100ml) as a solvent in an orbital shaker flask at 110 rpm under ambient conditions. After 5 days, extract of the plants were collected and stored individually[7].

III. METHODOLOGY:

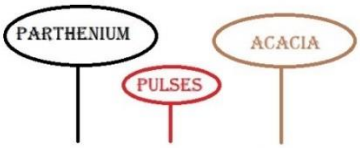
The following methodology has been framed and performed out of trial and error basis. 11 Paper cups were taken and each packed with red soil and planted with fast germinating pulses *Vigna unguiculata* and *Vigna radiata* of 5 each and totally 10 in number. Throughout this experiment, crude extracts were exploited in order to withhold the synergy molecules which may aid the metabolites created by the floras and other allelopathic molecules existing minimal in concentration. The cups were numbered from 1 to 11. The sample branded as number 1 was nourished with crude Parthenium extract of 10ml and the sample 2 (fig 1a) was fed with the solvent ethanol of 10ml since crude extract was used.

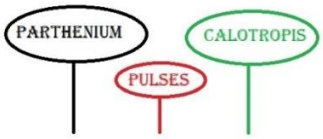


The sample 3 (fig 1b) was fed with the mixture of both Parthenium and *Cassia tora* extracts of 15 ml at 2:1 ratio.

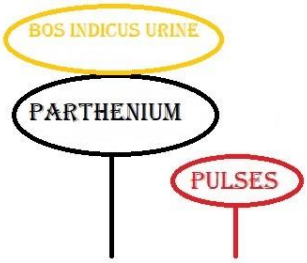


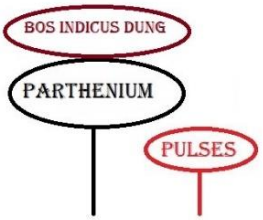
Similarly, the sample 4 and 5 (fig 1c, d) was fed with Parthenium & *Acacia concinna* and Parthenium & *Calotropis gigantea* extracts of 15 ml at 2:1 ratio.



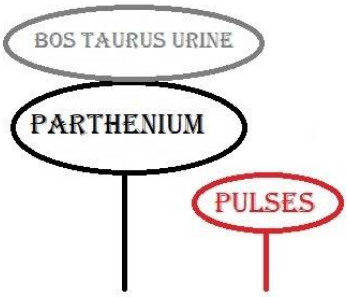


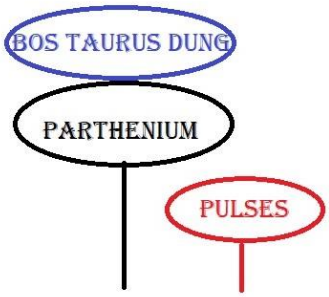
The sample 6 (fig 1e) was fed with Parthenium & *Bos indicus* (pure kangayam breed) urine of 15 ml at 2:1 ratio. Cup 7 (fig 1f) was fed with Parthenium & *Bos indicus* (pure kangayam breed) dung of 10ml and 5mg respectively.



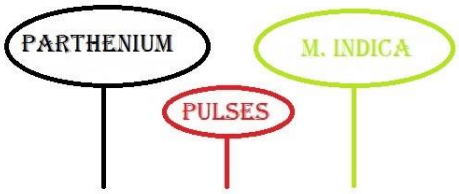


Similarly, for sample 8 and 9 (fig 1g, h), it was fed with Parthenium & *Bos taurus* (jersey cross breed) urine of 15 ml at 2:1 ratio and Parthenium & *Bos taurus* (jersey cross breed) dung of 10ml and 5mg respectively.





Sample 10 was fed with the mishmash of both Parthenium and *Mangifera indica* extracts (fig 1 i) of 15 ml at 2:1 ratio.



These plants were homogenously irrigated (7ml) for a period of 7 days. Cup 11 (fig 1 j) was served with no extracts and watered alone and kept as control. This experimental setup was repeated twice and observations were made.

IV. GC-MS ANALYSIS

Ethanolic extract of the superlative combination, Parthenium & *Calotropis gigantea* was analyzed through coupled GC-MS (Thermo make with trace ultra-version 5.0 and DSQ II MS model) was used. DB 35 – MS Capillary Standard non-polar column of length-30 m of internal diameter-0.25 mm and 0.25 µm film was employed for analysis. Electron ionization was implied with an ionization energy of 70 eV, carrier gas was helium at 1 ml/min flow rate and 1µl of injection volume were the active parameters of analysis. The injector was driven at 250 °C and automated oven temperature was from 70°C to 260°C with a rise of 6°C /min. The spectrum was obtained at 70 eV. The interpretation of compounds was centered on Willey and NIST libraries on appraisal of their retention time. The compounds identified were tabulated in table 1.[8] [9]

V. RESULTS AND DISCUSSION:

The interpretations made through this practice is as sample 1 with alone Parthenium extract showcases undersized growth and lessening in the no of seeds propagated. The sample 2 with ethanol was observed with better growth and the no of seeds sprouted from the 10 seeded. The sample 5 with Parthenium and *Calotropis gigantea* was good with respect to development and sprouting. The sample 3&4 with Parthenium & *Cassia tora* and Parthenium & *Acacia concinna* extracts also had good development and budding. No sign of growth was observed in sample 6, 7, 8 and 9 with Parthenium and cow excreta. Sample 10 with Parthenium and *Mangifera indica* extracts had good yield and propagation of seedlings. Similar results were obtained for repeated experimental setups.

Sample 11 as control had growth with respect to irrigation with water alone.

Sample 1 with a solo parthenium had stunted growth and reduced germination and this may be due to the existence of allelopathic phytochemical Parthenin and others etc. uttering its allelopathy potential against the seeds seeded. Ethanol with sample 2 was done in order to certify the solvent ethanol in crude extracts not exercising any effects over the pulses seeds other than Parthenium. Noble growth and germination in sample 2 reveals ethanol doesn't have any destructive effects over the seeds. The sample 4&5 with Parthenium and *Calotropis gigantea* & *Acacia concinna* were the superlative among the others with respect to growth and germination. There may be two prospects for the better growth and seedlings and they are, the *Calotropis gigantean and Acacia concinna* extracts may have a potential compound that could bind to the noxious parthenin and depollute it and the other case is that the plant may have some growth promoters that could have boosted the growth of the seeds infested by Parthenium. Parallel interpretations were made for sample 3, 4 and 10. Among these plant extracts, the detoxifying activity of *Cassia tora* was fewer. No growth in the samples 6, 7, 8 and 9 were witnessed may be because of the surplus meditation of urea in the feces of cow which could have inhibited the growth of the seedlings. The statistical data on the growth and germination of the seedlings in these cups after 10 days had been organized in a graphical representation.

		
a. Comparison between the *Parthenium hysterophorus* and Eth	*b.* Comparison between the *Parthenium hysterophorus and Cassia tora*	*c.* Comparison between the *Parthenium hysterophorus and Acacia concinna*

d. Comparison between the Parthenium hysterophorus and Calotropis gigantea

e. Comparison between the *Parthenium hysterophorus and Bos indicus urine*

f. Comparison between the *Parthenium hysterophorus and Bos indicus dung*

g. Comparison between the *Parthenium hysterophorus and Bos taurus urine*

h. Comparison between the *Parthenium hysterophorus and Bos taurus dung*

i. Comparison between the *Parthenium hysterophorus and Mangifera indica*

j. Comparison between the *Parthenium hysterophorus and control*

fig1. Comparison of growth inhibition of* Vigna unguiculata and Vigna radiate *against Parthenium hysterophous and its respective combinations

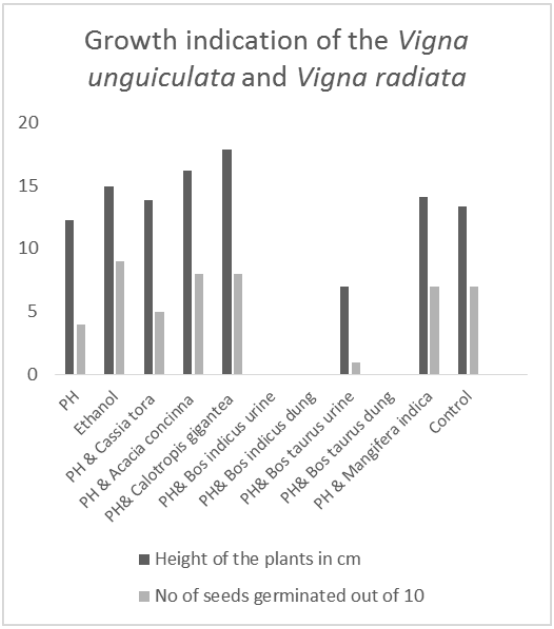


Fig 2 Growth indication of the Vigna unguiculata and Vigna radiata

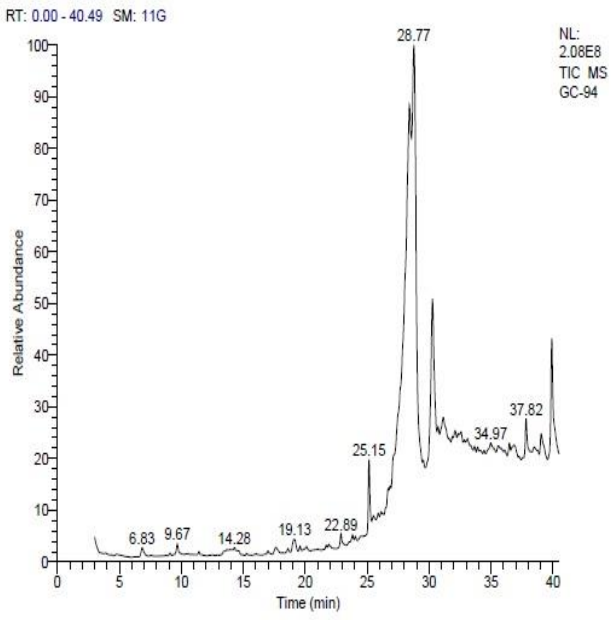
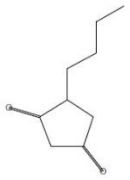
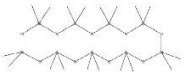
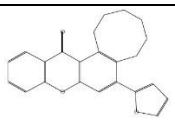
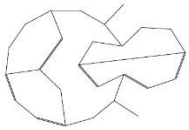
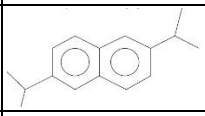
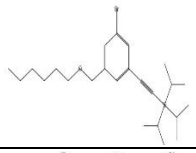
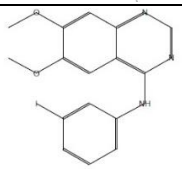
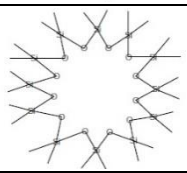
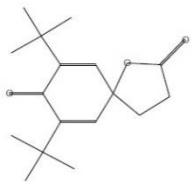


Fig 3 GC MS chromatogram profile of Parthenium hysterophorus and *Calotropis gigantea combination*

Table: 1 Putative identification of Compounds derived from the Ethanolic extracts of *Parthenium hysterophorus* & *Calotropis gigantea* mixtures

S. No	Retention Time	Compound name	Molecular Formula	Molecular weight	Area	Structure	Reference
1	6.83	1,3-Cyclopentanedione, 4-butyl-	C9H14O2	154	0.63		[10]
2	9.67	1-Tridecanol	C13H28O	200	0.60		[11]
3	9.67	1-Hexadecene	C16H32	224	0.60		[12] [13]
4	14.82	Cyclononasiloxane, octadecamethyl-	C18H54O9Si9	666	1.70		[14]
5	17.65	7-(2-Furyl)-1,2,3,4,5,6-hexahydro-14H-cycloocta[a]xanthene -14-one	C23H20O3	344	0.56		
6	17.65	Dimethyloctahydro[2,2](2,7)naphthalenoph Ane	C26H32	344	0.56		
7	19.13	2,6-Diisopropylnaphthalene	C16H20	212	1.10		[15]
8	20.08	1-Bromo-3-hexyloxymethyl-5-triisopropylsilylethynylbenzene	C24H39BrOSi	450	0.58		
9	20.08	4-N-(3'-Iodophenyl)amino-6,7-dimethoxyquinazoline	C16H14IN3O2	407	0.28		
10	21.91	Tetracosamethyl-cyclododecasiloxane	C24H72O12Si12	888	0.40		[16]
11	22.89	Hexadecanoic acid, ethyl ester	C18H36O2	284	0.67		[17]
12	23.82	7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione	C17H24O3	276	0.65		

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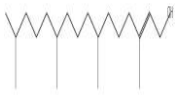
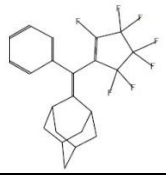
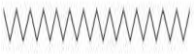
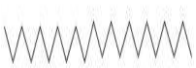
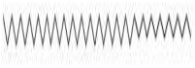
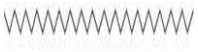
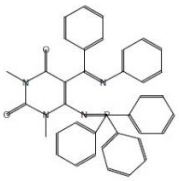
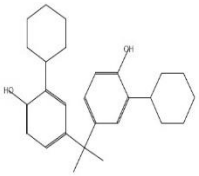
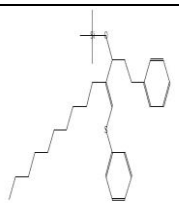
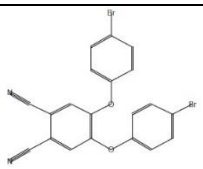
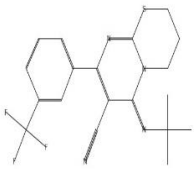
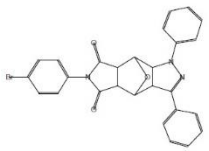
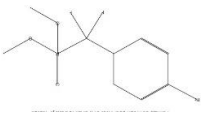
13	25.15	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [R-[R*,R*-(E)]]-	C20H40O	296	3.61		[18] [19]
14	26.68	Ethyl linoleate	C20H36O2	308	0.71		[20]
15	27.08	1-linolensaeure-sn-glycerylester-2,3-diace Tat	C25H40O6	436	0.63		
16	27.45	1-(1-Adamantylidene-1-phenylmethyl)-2,3,3,4,4,5,5-heptafluorocyclopentene	C22H19F7	416	0.28		
17	27.45	Dihydro-Monticoline	C22H35NO6	409	0.28		[21]
18	28.41	Nonacosane	C29H60	408	27.63		[22]
19	28.41	Docosane	C22H46	310	27.63		[22]
20	28.41	Tetratetracontane	C44H90	608	27.63		[23]
21	28.77	Dotriacontane	C32H66	450	31.39		[24]
22	28.77	Octacosane	C28H58	394	31.39		[24]
23	28.77	Heptacosane	C27H56	408	31.39		[24]

24	28.77	Pentatriacontane	C35H72	380	31.39		[24]
25	30.26	1,3-Dimethyl-5-(N-phenybenzimidoyl)-6-triphenylphosphoranylamino)pyrimidine-2,4(1H,3H)-dione	C37H31N4O2P	594	11.44		
26	31.16	4,4'-isopropylidene-bis-(2-cyclohexylphenol)	C27H36O2	392	1.92		
27	32.10	(E)-2-Decyl-5-phenyl-1-(phenylthio)-1-penten-3-ol trimethylsilyl ether	C30H46OSSi	482	0.51		
28	32.58	4,5-Bis(p-bromophenoxy)-1,2-dicyanobenzene	C20H10Br2N2O2	468	0.64		
29	33.11	6-(t-Butylimino)-8-(3'-trifluoromethylphenyl)-3,4-dihydro-2H, 6H-pyrimido[2,1-b][1,3]thiazine-7-carbonitrile	C19H19F3N4S	392	0.64		
30	34.97	tetrakis (Dimethylsilylcarbodiimide)	C12H24N8Si4	392	1.00		[25]
31	35.58	1-O-(ter-Butyldiphenylsilyl)-5-O-(tert-butyldimethylsilyl)-4-O-formyl-2,3-O-isopropylidene-á,D-fructopyranose	C32H48O7Si2	600	0.79		
32	36.11	1,3-Diphenyl-6-(p-bromophenyl)-3a,4,4a,7a,8,8a-hexahydro-4,8-epoxypyrrolo[3,4-f]indazole-5,7-(1H,6H)-dione-	C27H20BrN3O3	513	0.23		
33	36.48	4-[(Dimethylphosphono)difluoromethyl]bromobenzene	C9H10BrF2O3P	314	0.57		
34	36.84	1,3,8-trimethyl-4-propyl-5-ethyl-2-(1-hydroxyethyl)-7-methoxycarbonylethyl-6,ç-methylenecarbonyl-porphine	C36H42N4O4	594	1.33		
35	37.82	1(10)-Methoxy-6-thia-1(1,8)-anthracena-4,8(1,3)dibenzacyclodeca-2,9-diynaphane	C33H22OS	466	1.75		

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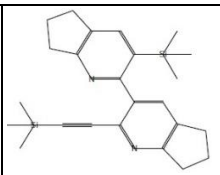
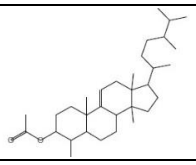
38	38.49	3-Trimethylsilyl-2'-[2'-(trimethylsilyl)ethynyl]-2,3'-bipyridine	C24H32N2Si2	404	0.58		
39	39.04	6,8-dibromo-2-(3-pyridyl)-4-phenyl-quinazoline	C19H13Br2N3	441	1.65		[26]
40	39.90	4à,14à,24-trimethyl-9(11)-cholesten-3á-yl acetate	C32H54O2	470	6.02		[9]

VI. GC-MS ANALYSIS:

The GC-MS profile of ethanolic extract analysed for the presence of bioactive molecules is represented in fig 3 which showed the noticeable peaks for the existence of 40 bioactive complexes. Among the compounds, 1-Hexadecene used as a solvent, organic intermediate, ignition standard for diesel fuels and also used for the production of detergents. It causes Dermatitis in humans. Acute exposure to hexadecane causes irritation, CNS depression, and gastrointestinal tract irritation. Tetratetracontane could be utilised in ointments owing to its thickening, lubricative and anti-inflammatory properties. It also finds its use as an embedding material in the microscopic structural study of tissues. Hexadecanoic acid ethyl, a fatty acid ethyl ester formed upon extreme intake of alcohol thereby increasing Ca^{2+} concentration in turn causing injury to the pancreatic acinar cell. 2,6-diisopropylnaphthalene used as multipurpose solvent, chemical intermediate and as a substitute for polychlorinated biphenyls. Ethyl linoleate used mainly as fragrant material and as an emollient. It is also utilized for the identification of alcohol abuse, as a standard material in quantification of fatty acid ethyl esters (FAEEs). Linoleic acid ethyl ester (Ethyl linoleate) is a acetylcholinesterase (AChE) antagonist. Apart from these other higher alkanes like nonacosane, docosane, tetratetracontane, dotriacontane, octacosane, heptacosane, pentatriacontane are present which has various laboratory uses.

VII. CONCLUSION:

Numerous Plant extracts were engaged in this biochemical organization as a screening progression in order to recognize the plants with such bio potency to counter the lethal allelopathic Parthenin and to facilitate the development of plants diseased by the phytochemicals of Parthenium. Superlative fallouts were obtained in the extracts of *Calotropis gigantea and Acacia concinna* with respect to growth and propagation of the seedlings which may of the forecasts as stated above that these extracts may comprehend a potential compound that could bind to the toxic parthenin or else this extract might possess growth promoters that could boost the growth of the seeds affected by parthenin. This method is viable for the farmers to procure and practice in their vegetation and elude overpowering of the weeds. The GCMS analysis revealed the presence of various allergic compounds and other vital bioactive compounds with various properties. Our forthcoming toil is to detect these vital compounds or the growth factors and formulate them into a nourishing spray to guarantee the harvest is not affected.

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