FINAL REPORT

1. MONOCULTURE

In the present project study *P.karka , A.donax* and *E.crassipes* were collected from water Logged Area (locally called sem) along with Gang Canal, Bhakra Canal, Indra Gandi Nahar Pariyojana (IGNP) canal system in Sri Ganganagar. These collected plants transported in Polythene bags to Botanical garden, College campus (study site).Their monocultures were raised and maintained separately in concrete tanks in the botanical garden in college campus. The monoculture of these plants used for experiments against test crops viz., wheat (*Triticum aestivum* L.variety Raj.1482), rice (*Oryza sativa* L.variety PR-106) and Mustard (*Brassica juncea* variety RNG-48)

2 *IN VITRO* EXPERIMENTS

The *in vitro* seed germination and seedling growth bioassay experiments were performed in petriplates using 3% aqueous leachate of *P.karka, A.donax* and *E.crassipes* wheat, rice and Mustard. In *in vitro* experiments 3-5 replicate used for each test crops. The seedlings were harvested 7 days after sowing and germination of seedlings, lengths of root, shoot and total dry weight of seedlings were measured.

The effects of in vitro experiments on test crops are

a. Allelopathic impact of *P.karka* on wheat, rice

In the present study 3% (w/v) aqueous leachate of above ground (Ag) and below ground (Bg) plant parts of *P.karka* was studied on the germination and growth of wheat seedlings. The aqueous leachate of Ag plant parts has no impact on wheat seedlings whereas Bg plant parts increased the all parameters such as germination, root, shoot length and dry weight of wheat seedlings. The root length remained only 98 % of control in Ag part whereas it increased up to 114% of control in Bg part. In case of shoot, the length of wheat seedlings was 98 and 108% of control in Ag and Bg parts respectively. Likewise, total dry weight was also found 98 and 109 % of control in Ag and Bg parts respectively at 7 DAS **(Table 1).**

The study shows the impact of 3% (w/v) aqueous leachate of *P.karka* on germination and growth of rice seedlings. The aqueous leachate of both Ag and Bg parts of *P.karka* effectively increased the germination and growth of rice seedlings. The % germination was 104% of control in both Ag and Bg parts. The root length 102 % of control in Ag part on the other hand it sharply increased to 150 % of control in Bg part. In case of shoot, the length was 126 and 146% of control in Ag and Bg parts respectively. Likewise, total dry

weight also showed an increase and observed 128% of control in Ag and 156% of control in Bg part at 7 DAS. The results show that *P.karka* enhanced the growth of wheat and rice seedlings **(Table 2).**

b. Allelopathic impact of *E.crassipes* on wheat and rice

In the present project study 3% aqueous leachate of both Ag and Bg parts of *E.crassipes* effectively increased the germination of wheat seedlings. The % germination was 100 and 108% of control in Ag and Bg parts, respectively. The root length was 118 and 126% of control in Ag and Bg parts, respectively. In case of shoot length, it was 108 and 112 % of control in Ag and Bg parts, respectively. Similarly, total dry weight also showed an increase of 106 and 112% of control in Ag and Bg parts, respectively at 7 DAS **(Table 3).**

In another experiment the allelopathic impact of *E.crassipes* on rice seedlings the root length 104% of control in Ag parts whereas it markedly increased to 156% of control in Bg. In case of shoot, the length was 107 and 122% of control in Ag and Bg parts, respectively. Similarly, total dry weight also increased up to 136 and 158% of control in Ag and Bg parts respectively at 7 DAS **(Table 4).**

c. Allelopathic impact of *E.crassipes* on Mustard

In the present project study 3% aqueous leachate of both Ag and Bg parts of *E.crassipes* effectively increased the germination of Mustard seedlings. The % germination was 100 and 98% of control in Ag and Bg parts, respectively. The root length was 112 and 131% of control in Ag and Bg parts, respectively. In case of shoot length, it was131 and 146% of control in Ag and Bg parts, respectively. Similarly, total dry weight also showed an increase of 147 and 152% of control in Ag and Bg parts, respectively at 7 DAS **(Fig.1).**

3. SMALL POT CULTURE EXPERIMENTS

In the present project study small pot culture experiments were performed using small plastic disposable pots (7x4cm). The pots were filled with garden soil, three replicates maintained for each treatment and control. Five seeds of test crops were placed at equidistance in each pot. The 30 days exudation of *P.karka* and *E.crassipes* plant was added in each treated pot. The control sets were treated with tap water.

a. Impact of exudation of *P.karka* on rice and wheat seedlings

The present experiment shows the impact of 30 days exudation of *P.karka* on germination and growth of rice seedlings. The root length and shoot length was 124% and 185% of control respectively. Likewise, total dry weight also showed an increase and observed 137% at15 DAS. In wheat experiment the root length was 124% of control where as in case of shoot, the length was 185% of control. Likewise, total dry weight was 137% of control at 15 DAS of wheat seedlings **(Table 5& 6)**.

b. Impact of exudation of *E.crassipes* on rice and wheat seedlings

This experiment shows the impact of 30 days exudation of *E.crassipes* on germination and growth of rice seedlings in small pot experiments. The root length and shoot length was 145% and 175% of control respectively. Likewise, total dry weight also showed an increase and observed 135 % at 15 DAS. The 30 days exudation of *E.crassipes* also increased all the parameters of wheat seedlings. The root length and shoot length was 155% and 149% of control respectively. Likewise, total dry weight also showed an increase and observed 135% of control at 15 DAS of wheat seedlings **(Table 7& 8, Fig 2&3)**.

4. MAJOR POT EXPERIMENT

Pot culture experiment was performed (impact of dry matter of *E.crassipes* and *P.karka* on wheat and rice in pots) against the chemical fertilizer and control treatment.

Setup of pot experiment

The allelopathic potential of *E.crassipes*, *P.karka* and chemical fertilizer were investigated on the wheat and rice crops in pot experiment. The three replicate of each treatment was set up in earthen pots (32 x 14cm). The soil was treated by adding dry powder of plant material into the soil at 3% concentration (weight /weight) prior to sowing of seeds in pots. The pots were filled with about 3.9 kg garden soil. Three treatments with control set were made for experiment. In *E.crassipes* and *P.karka* treatment around 6cm layer of the top soil of each pot was removed (approximately1.5 kg) and mixed with dry matter (45g) of *E.crassipes* and *P.karka* in ratio of 3% (w/w) and refilled in earthen pots. In third treatment, the soil was treated with chemical fertilizer. The chemical fertilizer was applied in combination with NPK as 20kg N, 22 kg P and 42 kg K per hectare.

a. Experiment on wheat

Results of pot culture experiment on wheat

The data in given tables shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in pot experiment at 21, 42, 63, 84, 105 and 126 days after sowing (DAS). The 3% (w/w) dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters in all the treatments.

First harvest

The data in **Table 9** shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in pot experiment 21 days after sowing (DAS).The 3% (w/w) dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 104% of control in *E.crassipes* treatment whereas it increased up to 138% of control in *P.karka*. In case of shoot, the length was 124, 111 and 116% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 123, 124 and 127% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. The ANOVA was found significant in all parameter. The 3%

(w/w) dry matter of *E. crassipes*, *P.karka* and chemical fertilizer enhanced the growth of all parameters of wheat seedlings at 21DAS (**Fig 4)**.

Second harvest

The data in **Table 10** shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in major pot experiment after 42 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of all parameters of wheat seedlings. The root length was 109 % of control in chemical fertilizer whereas it increased up to 111 and 116 % of control in *E.crassipes* and *P.karka* respectively. In case of shoot, the length was 105, 118 and 113% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was found 151, 141 and 152% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 42 DAS. The best promoting results were observed in chemical fertilizer thereafter *E.crassipes.*

The ANOVA was found significant in all parameter. The Dunnett's test proved that 3% dry matter of *E.crassipes* and *P.karka* was highly significant for all the parameters of wheat seedlings after 42 DAS in pot experiment in natural condition **(Fig 5, Plate 1)**.

Third harvest

The data in **Table 11** shows the successive stages of growth in the all parameters of wheat crop in pot experiment after 63 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 112 % of control in *E.crassipes* whereas it increased up to 121 % of control in *P.karka*. In case of shoot, the length was 104, 112 and 103% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was found 154,161 and 165% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 63 DAS.

The ANOVA was found significant in all parameter. The Dunnett's test proved that 3% dry matter of *E.crassipes* and *P.karka* was significant for all the parameter of wheat plants in pot experiment.

Forth harvest

The data in **Table 12** shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in pot experiment after 84 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 103% of control in *E.crassipes* whereas it increased up to132 % of

control in *P.karka* as compare to chemical fertilizer where it was 125% of control. In case of shoot, the length was 108, 110 and 103% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was found 106, 114 and 113% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 84 DAS. In all parameters the best promoting results were observed in chemical fertilizer there after *E.crassipes* treatment. The ANOVA was found significant in all parameter. The Dunnett's test proved that *E.crassipes*, *P.karka* has significant impact on growth of wheat seedlings in pot experiments **(Fig 6)**.

Fifth harvest

The data in **Table 13** shows the successive stages of growth of all parameters of wheat plants in pot experiment after 105 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 112% of control in *E.crassipes* whereas it increased up to 126 % of control in *P.karka*. In case of shoot, the length was 103, 104 and 106% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 106, 116 and 118% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 105 DAS. The best promoting results in all

parameters were observed in chemical fertilizer there after *E.crassipes* treatment. The ANOVA was found significant in all parameter.

Sixth harvest

The data in **Table 14** shows the successive stages of growth of all parameters of wheat plants in pot experiment after 126 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 112% of control in *E.crassipes* whereas it increased up to 129 % of control in *P.karka*. In case of shoot, the length was 103, 104 and 106% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 104, 108 and110% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 126 DAS. The ANOVA was found significant in all parameter **(Fig 7)**.

Leaf area

The leaf areas of different harvests are presented in **Table 15.**

Yield Attributes of pot experiment

The effect of incorporation of 3% (w/w) dry matter of *E.crassipes, P.karka* and chemical fertilizer on the yield attributes of wheat crop viz. ear length and grain per ear is presented below**.**

Ear length

The ear length was reported 107,111and 107% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 84 DAS. The ear length was reported 111,112 and 108% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively after 105 DAS. The ear length was reported 114,116 and 112% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively in last harvest **(Table 16, Fig 8 and Plate 2)**.

Grain yield

The allelopathic impact of 3% w/w dry matter of *E.crassipes, P.karka* and chemical fertilizer on the grain yield of wheat seedlings is presented in **Table 17**. The data indicates that grain per ear of wheat seedlings is reported highest 124 % of control in *P.karka* and lowest in *E.crassipes* (119% of control). The grain yield (g/ plant) is highest 130 % of control in *P.karka* and lowest in chemical fertilizer treatment. The 1000 grains weight is 106, 119 and 116% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. The grain yield (kg/h) is highest in *P.karka* treatment. The chlorophyll a, b, total chlorophyll, protein and reducing sugar of pot experiments presented in **Table 18 &19.**

Physico-chemical characteristics of soil of pot experiment on wheat

The physico-chemical characteristics of pot experiment were analyzed at an interval of 40 DAS table. The pH in control, chemical fertilizer, dry matter of *E.crassipes* and *P.karka* was found close to neutral (7.6 to 8.01).The value of EC range from 0.76 to 0.81 dc/m in all the sets. The electric conductivity was higher in all the sets at zero DAS but gradually decreased at each harvest except chemical fertilizer where it gradually increased from 0.71to 0.76 to dc/cm at 40 DAS. The highest EC was recorded in dry matter of *E.crassipes* at 40 DAS. The Carbon (%) and Nitrogen (%) was reported highest in *P.karka* treatment. Phosphorus (Kg/ha), Potash (Kg/ha), Zinc (ppm), Cupper (ppm), Ferrous (ppm), Manganese (ppm) and Sulphur (ppm) are also recorded at every 40, 80 and 120 DAS. The highest macronutrient and micronutrient reported in *E.crassipes* and *P.karka* treatment **(Table 20, 21 & 22).**

Quantitative estimation of total phenols in *Eichhornia crassipes* and *Phragmites karka*

The Quantitative estimation of total phenols in *Eichhornia crassipes* and *Phragmites karka* are show in **Table 23 (Fig9).**

b. Experiment on rice

Results of pot experiment on rice

The data in given tables shows the successive stages of growth in root, shoot length and total dry weight of rice seedlings in pot experiment. The 3% (w/w) dry matter of *E.crassipes*, *P.karka* enhanced the growth of rice seedlings in all parameters in all treatments.

First harvest

The data shows the successive stages of growth in root, shoot length and total dry weight of rice seedlings in pot experiment 40 days after sowing. The 3% (w/w) dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of rice seedlings in all parameters. The root length was 102% of control in *E.crassipes* treatment whereas it increased up to 138% of control in *P.karka*. In case of shoot, the length was 124, 122 and 116% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 132, 122 and 127% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively **(Fig 10).**

Second harvest

The data shows the successive stages of growth in the all the parameters of rice crop in pot experiment after 80 DAS. The 3% dry matter

of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of rice seedlings in all parameters. The root length was 122% of control in *E.crassipes* whereas it is 119% of control in *P.karka*. In case of shoot, the length was 114,112 and 109% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 157,152 and 156% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 80 DAS **(Fig 11).**

Third harvest

The experiment shows the successive stages of growth of all parameters of rice plants in pot experiment after 120 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of rice seedlings in all parameters. The root length was 110% of control in *E.crassipes* whereas it increased up to 116 % of control in *P.karka*. In case of shoot, the length was 109, 107 and 111% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 104, 108 and 110% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 120 DAS **(Fig 12).**

5. FIELD TRIAL

Field experiment on wheat

The field experiment was performed to relate the *in vitro* results in natural field conditions. In the project study field experiment performed in botanical garden. The allelopathic potential of *E.crassipes*, *P.karka* and chemical fertilizer were investigated on the wheat crop in field experiment. The experiment was set up in botanical garden in small plots of 60x60 cm with three replicate of each treatment. The soil was treated by adding dry powder of plant material into the soil at 3% concentration (weight /weight) in upper 5cm soil prior to sowing of seeds in field. Three treatments with control set were made for experiment. The chemical fertilizer was applied in combination with N P K as 20kg N, 22 kg P and 42 kg K per hectare.

First harvest

The data shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in field experiment at 40 days after sowing (DAS). The 3% (w/w) dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 115% of control in *E.crassipes* treatment whereas it increased up to 132% of control in *P.karka*. In case of shoot, the length was

114, 117 and 106% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 124, 147 and 138 % of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. The ANOVA was found significant in all parameter. The 3% (w/w) dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters at 40 DAS.

Second harvest

The data shows the successive stages of growth in root, shoot length and total dry weight of wheat seedlings in field experiment after 80 DAS. The 3% dry matter of *E.crassipes* and *P.karka* enhanced the growth of wheat seedlings in all parameters. The root length was 102 % of control in *E.crassipes* whereas it increased up to 128 % of control in *P.karka.* In case of shoot, the length was 141, 143 and 130% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 143, 142 and 140% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 80 DAS. The best promoting results were observed in *E.crassipes.* The ANOVA was found significant in all parameter. The Dunnett's test proved that 3% dry matter of *E.crassipes* and *P.karka* was highly significant for all the parameters of wheat seedlings after 80 DAS in field experiment in natural condition **(Fig 13).**

Third harvest

The data shows the successive stages of growth in the all parameters of wheat crop in field experiment after 120 DAS. The 3% dry matter of *E.crassipes*, *P.karka* and chemical fertilizer enhanced the growth of wheat seedlings in all parameters. The root length was 109 % of control in *E.crassipes* whereas it increased up to 116 % of control in *P.karka*. In case of shoot, the length was 127, 124 and 125% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively. Likewise, total dry weight was also found 146,151 and 150% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively at 120 DAS.

Yield Attributes of Field trial

The effect of incorporation of 3% (w/w) dry matter of *E.crassipes, P.karka* and chemical fertilizer on the yield attributes of wheat crop viz. ear length and grain per ear is presented in table**.** The ear length was reported 112,111and 114% of control in *E.crassipes*, *P.karka* and chemical fertilizer respectively after 120 DAS. The data indicates that grain per ear of wheat seedlings is reported highest 121% of control in *E.crassipes* and lowest in *P.karka* (119% of control).

Discussion

Allelochemicals like plant hormones show both growth promoting and inhibiting properties depending upon its concentration. Both detrimental and beneficial impacts of allelochemicals are the major tools in the integrated management of natural and manipulated ecosystems. The use of phytochemicals of *E.crassipes* and *P.karka* in the form of dried plant material in the wheat crop can replace the hazardous chemical fertilizer. *E.crassipes* contains growth promoting allelochemicals and growth hormone gibberellic acid (GA) in its roots and rhizomes, which promotes the growth of wheat crop. *P.karka* has growth promoting allelochemicals which significantly promotes the growth of wheat crop. The phytochemicals of these two plants may be useful for soil remediation that may be proved beneficial for sustainable management of agroecosystems. In this present project study pot experiment proves that allelochemicals of these two plants promote all the parameters of wheat crop and use as compost in wheat field.

Conclusion

Beneficial impacts of allelochemicals are the major tools in the integrated management in agricultural ecosystems. *E.crassipes*, *P.karka* and *A.donax* possess natural compost and eco-friendly properties so it can be reduce the use of fertilizer and synthetic herbicides in Indian agriculture. The waste material of these aquatic macrophytes can be used for soil remediation and sustainable management of agroecosystems as organic compost. These large scale chemicals fertilizers cause a lot of hazards to man, i.e., ecological pollution, soil health, agro-ecology and poor productivity in agriculture field.

Modern agriculture is faced with the challenge of becoming more productive and more sustainable to meet the food and other requirement of the ever-growing population of the world. In mid-19th century introduction of synthetic herbicides, pesticides and chemical fertilizer in agriculture was a welcome move to meet the desire outcome in the agriculture. However excessive use of the hazardous chemical fertilizer, synthetic herbicides, pesticides and weedicide has crushed down the agriculture soil in Haryana, Punjab and Sri Ganganagar-Hanumangarh district of Rajasthan.

Organic farming is method of growing crops without the use of any synthetic agricultural chemicals. The use of hazardous chemical fertilizers, synthetic herbicides and weedicides in the crop field may be replaced by the phytochemicals of aquatic macrophytes in the form of natural compost.

This study involves the large scale *in vitro*, green house, garden as well as field experiments by using green manure of aquatic macrophytes such as *Eichhornia crassipes* (Jal kumbhi), *Phragmites karka* (Reed), *Arundo donax* and *Typha angustata* in crop field. These aquatic macrophytes are found everywhere in canal system, water logging areas as aquatic waste weed in Punjab, Haryana and Rajasthan. These aquatic macrophytes are also present in large amount in water logging area (Sem) along with Indra Gandi Nahar Pariyogna (IGNP). The organic matter of these aquatic macrophytes is used to produce green manure for organic cotton in Sri Ganganagar-Hanumangarh district. The dry matter of water hyacinth (*Eichhornia crassipes*) can be used as compost due to its high rate of production and mineral composition.These aquatic macrophytes accumulate the valuable minerals and nutrients which may be useful for sustainable cotton / green cotton productions. These aquatic macrophytes can reduce the heavy

dependence on chemical fertilizers and synthetic herbicides and weedicide in sustainable crop productions. Cotton growing belt has also adverse effect on environment mainly due to application of different types of fertilizer in huge quantity. *E.crassipes* contains growth promoting allelochemicals and growth hormone gibberellic acid (GA) in its roots and rhizomes, which can promotes the growth of wheat, rice and other crops. The use of organic compost of water hyacinth also increase yield in lot of crops.The water hyacinth finds of its best use in soil amendment and as compost due to its high rate of production and mineral composition.

SUMMARY

Allelochemicals like plant hormones show both growth promoting and inhibiting properties depending upon its concentration. Both detrimental and beneficial impacts of allelochemicals are the major tools in the integrated management of natural and manipulated ecosystems. The use of phytochemicals of *E.crassipes* , *A.donax* and *P.karka* in the form of dried plant material in the wheat, rice and mustard crops can replace the hazardous chemical fertilizer. *E.crassipes* contains growth promoting allelochemicals and growth hormone gibberellic acid (GA) in its roots and rhizomes, which promotes the growth of wheat and rice crops. *P.karka* has growth promoting allelochemicals which also promotes the growth of wheat and rice crops. The phytochemicals of these two plants may be useful for soil remediation that may be proved beneficial for sustainable management of agroecosystems. In this present project study *in vitro,* pot experiment and field trials proves that allelochemicals of these two plants promote all the parameters of wheat and rice crops and use as compost in agricultural crops in the field.

The present study indicated that *E.crassipes, A.donax* and *P.karka* has growth promoting allelochemicals which significantly promoted the growth of wheat and rice seedlings in bioassay as well as in pot and in the

field conditions.The soil fertility improved when the phytochemicals of *E.crassipes, A.donax* and *P.karka* were added into it in the form of dry matter. Moreover, above ground parts of *P.karka, A.donax* and *E.crassipes* can be used as a suitable material for mulch for wheat field to improve soil fertility.

Thus, the present project recommended that the use of phytochemicals of *E.crassipes, A.donax* and *P.karka* in the form of dried plant material in the field of wheat and rice can replace the hazardous chemical fertilizer for better ecofriendly grain yield. In addition to this, the phytochemicals extracted from the plants may be useful for soil remediation that may prove beneficial for sustainable maintenance of agroecosystems.