International Journal of Biology Research
ISSN: 2455-6548
Impact Factor: RJIF 5.22
www.biologyjournal.in
Volume 3; Issue 1; January 2018; Page No. 91-97

Ecophysiological characteristics of selected dominant weeds of Sarguja division Chhattisgarh (India)

[*1] Dr. Mantosh Kumar Sinha, [2] Arnab Banerjee
[1] Principal, KR. Technical College, Sarguja University, Ambikapur, Chhattisgarh, India
[2] Assistant Professor, UTD Department of Environmental, Science Sarguja University, Ambikapur, Chhattisgarh, India

Abstract
The present investigation reports the variation in the ecophysiological attributes of some selected dominant weed species of Sarguja Division. Seeds of *Cyperus iria*, *Cyperus flavidus, Echinochloa colona* were collected from the fields of selected study sites and their eco-physiological attributes were studied. There was significant variation in various eco-physiological attributes of studied weed species. From the results it was found that highest reproductive output were reported by *Cyperus iria*. From percentage seed viability and germination percentage perspectives *Echinochloa colona* were found to be the major species to sustain in different study sites. Proper strategy should be implemented to control the population growth and spread of *Echinochloa colona* in the concerned study sites.

Keywords: Chhattisgarh, Sarguja division, ecophysiology, weed

Introduction
Very little is known about the biology of weed floras that invade and reduce the crop yields in Sarguja Division, Chhattisgarh, India. Such information is very much important to determine their potential for occurrence and abundance in certain microhabitats and also helps to predict if such species are on the verge of massive range extensions. such information provides sound ecological base for weed management in the agricultural field which may therefore promote agricultural productivity. The species ecophysiological responses to environmental conditions, together with additional aspects of their biology may also help us in future prediction of occurrence of other species bearing similar characteristics. Very little information were available about the environmental attributes that trigger seed germination and promote seedling growth and development weeds common to the Sarguja region. It has long been recognized by having knowledge about the required environmental condition for seed germination and seedling development, a better knowledge about the density and composition of a plant population can be acquired (Harper 1977) [11]. Such conditions vary significantly (Holt, 1988; Wilson 1988) [12] information regarding successful germination, emergence, seedling growth seedling growth and development may be used as a valuable tool for predicting weed occurrence and to develop sustainable techniques to promote weed control. (Radosevich & Holt 1984) [27]. Dormant seeds are of least concern from weed control measures, germinating seeds are often vulnerable to most control techniques. Thus information about factors promoting weed growth is vital for strategy formulation in weed control programmes. Tiwari Anushree (*et.al*. 2014) [34] A field survey was conducted at five different sites in Bilaspur district Chhattisgarh, during winter they are identify the diversity and distribution of weed species growing in association with cultured crops and to determine their competitive ability against the infesting weeds. They have studied deals with diversity and distribution of weeds in agriculture fields of Bilaspur district CG. The sixty nine species and 57 genera belonging to 22 families were identified.
Singh Vartika (*et.al*. 2015) [33] They have worked ecophysiological parameters for a wheat crop found in the Indo-Gangetic Plains of India and its five dominant weeds. The dominant and regionally ubiquitous weeds in the wheat field that was selected for the study were *Anagallis arvensis*, *Chenopodium album*, *Melilotus albus*, *Phalaris minor* and *Rumex dentatus*. Taller weeds, such as *C. album* and *P. minor*, constituted one group along with the crop, with a low photosynthetic rate, specific leaf area, leaf nitrogen mass basis, chlorophyll content, photosynthetic nitrogen-use efficiency and leaf area ratio, in comparison to shorter weeds. The result indicates that any weed management in the wheat fields of the Indo-Gangetic Plains
Understanding of biology of the plant species is necessary to cope with the environmental flux. Critical phases in the ecological life cycle of the population limit their size in time and space. The seed functions as the reproductive unit and links the successive generations. The seed contains the latent miniature plant and has many devices for its role as a dispersal unit. The viability, dormancy and conditions required for germination of different seeds and growth pattern are all interrelated. Germination of seed is the beginning of the life activities of a plant. Seed germination is the transition from seed to seedling. Certainly, in terms of stand establishment of weed or crop successful germination is of critical importance. Growth is a gradual increase in size by natural development. With the point of view of weeds and crops this is considered as an integrated feature of the whole plant living in its natural environment. During the present investigation the main objective of the present study was to assess the ecophysiology

of the dominating weeds for their successful establishment in the paddy fields of selected sites of Sarguja division under prevailing environmental conditions.

Materials and Methods

The mature seeds of *Echinochloa colona*, *Cyperus iria* and *Cyperus flavidus* were collected from fields, and stored in glass stoppered bottles. These were used as experimental materials. Following methods were used to study different aspects:

Morphology of seed

Seed Size

Twenty seeds from all the study sites were selected at random. These were divided in three lots (3 replicates) of 10 seeds each. Seeds were mounted on slides and measurements of length and breadth were taken under a travelling microscope, fitted with a vernier scale. Seed size was also measured with the help of screw gauge wherever it was found necessary. On the basis of the data thus obtained, average length and breadth and standard deviation was calculated.

Shape of seeds

The shape of the seeds of dominant weeds was taken by visual observation.

Seed Weight

Ten lots of one thousand seeds from each of the four localities were selected at random and their weight was determined on a single pan electronic balance. The average weight of 1000 seeds and standard deviation were calculated from the data thus obtained.

Seed Output

Ten separate plants from the localities were selected at random and seeds were directly counted on them. These were replicated three times. From the data thus obtained mean seed output and standard deviation were calculated.

Reproductive Capacity

Reproduction capacity was calculated using formula given by Salisbury (1942) –

Reproductive Capacity = x Average % germination

Seed Germination

Seeds were collected at various time intervals from crop fields and stored in polythene bags or glass stoppered bottles. These were tested first for viability and then for germination. Seed collection of previous season was also tested for the same.

Viability of Seeds

Seeds were thoroughly washed in ordinary water and soaked in distilled water for 24 hours. Fifty seeds of each weed species were dissected and put in 0.1% solution of 2,3,5-triphenyl tetrazolium chloride (TTC) in dark. Development of pink colouration in the embryo was taken to be the indication of the viability of seeds.

Germination

Seed germination experiments were performed in Petri-dishes lined with double layers of filter paper moistened with distilled water. Experiments were performed in triplicates of 50 seeds each. The seeds stored for more than four months at room temperature were used. At first, seeds were surface sterilized with 0.1% mercuric chloride solution and then kept for germination. Visual detection of radicle were taken to be the criterion for germination.

Growth Performance

Since the seedling mortality was very high in both the weed species the growth performance was observed in field conditions. The fully grown plants of *Cyperus iria*, *C. flavidus* and *Echinocloa colona* were collected from all the four study sites. Ten plants from each site were taken to the lab; carefully washed off the adhering soil particles, particularly in roots; and the measure-ments of different growth attributes were taken. The root system was gently pressed between sheets of blotting paper to absorb water adhering on its surface. The height of the plant was measured as the distance between the basal node and the tip of the spike. Plants were dried at 800c ± 200c in an oven till constant dry weight were obtained.

Results

The present study reports the ecophysiological attributes of selected weed species in different study sites of Surguja division.

Table 1: Ecolphysiological attributes of dominant weeds

Parameters	***Cyperus iria***			
	Baikunthpur	**Manedragarh**	**Sonhat**	**Khadgawan**
Seed Size (mm)	0.23 ± 0.014	0.20±0.024	0.18±0.21	0.21±0.024
Seed Weight (mg)	249.16±1.373mg	253.12mg	255.62mg	259.31mg
Reproductive Capacity	9343.55	8492.58	7319.79	6206.20
Germination (%)	36.14	34.53	33.51	34.39
% Viability	17.62	16.64	16.62	15.64
Growth Performance	28.55 ± 1.55 cm.			
Cyperus flavidus				
Parameters	Baikunthpur	Manedragarh	Sonhat	Khadgawan
Seed Size (mm)	0.090±0.001	0.86±0.002	0.090±0.003	0.090±0.001
Seed Weight (mg)	174.10	170.67	175.82	177.13
Reproductive Capacity	3068.7	3234.05	3194.55	3027.77
Germination (%)	37.66	37.33	37.83	34.66
% Viability	60.83	61.50	61.44	61

Growth Performance	46.30 ±1.66 cm.			
	Echinochloa colona			
	Baikunthpur	Manedragarh	Sonhat	Khadgawan
Seed Size (mm)	0.50±0.021	0.48±0.020	0.057±0.005	0.49±0.011
Seed Weight (mg)	496.73mg	496.74mg	496.88mg	497.76mg
Reproductive Capacity	2224.42	2041.93	1758.56	1894.9
Germination (%)	60.39	59.31	61.16	55.44
% Viability	58.26	57.27	60.24	57.68
Growth Performance	66.30 ±2.36 cm.			

Seed Size

The seed size of *Cyperus iria* ranged between 0.18mm to 0.23 mm at four different study sites. The seed size of *Cyperus flavidus* ranged between 0.09mm to 0.86mm. The seed size of *Eichinochloa colona* ranged between 0.050mm to 0.057mm. Highest seed size were recorded by *Cyperus flavidus*. There is significant level of variation of seed size of each dominant weed species among four study sites.

Seed Weight

Results clearly reveal that seeds were so light in weight that weight of 1000 seeds of *Cyperus iria* ranged between 249.16±1.373 mg to 259.36±0.834 mg among all the study sites.

Echinochloa colona seeds were a little bit heavy as compared to that of *Cyperus iria* and their average weight per 1000 seeds ranged between 496.73 mg to 497.76 mg. in all the study sites.

However, *Cyperus flavidus* seeds were lightest of all the three weeds species, weighing between 174.10 to 177.13 mg.

Shape of the seed

Shape of the seeds of *E. colona* was "elliptical-ovate" while it was "inflated-elliptic" in *Cyperus iria* and *C. flavidus*.

Reproductive Capacity

A look at the gives a clear picture of high seed output of all the three dominating weeds. *Cyperus iria* ranked first in terms of its seed output, having an output range of 14260.26 to 16176.36. *Cyperus flavidus* ranked second, producing as many as 7939.96±146.17 seeds per plant. *Echinochloa colona* had an output of 3213.26±137.30 to 3688.43±57.73 in all the study sites. There is significant level of variation in seed output and reproductive capacity of studied weed species among the different study sites. Reproductive capacity of *Cyperus iria* was found to be 9343.55 in Baikunthpur; 8492.58 in Manendragarh; 7319.79 in Sonhat, and 6206.20 in Khadgawan sites.

Reproductive capacity of *C. flavidus* was 3068.70 (Baikunthpur), 3234.05 (Manendragarh), 3194.55 (Sonhat,) and 3027.77 (Khadgawan).

Reproductive capacity of Echinochloa colona was 2224.42 (Baikunthpur), 2041.93 (Manendragarh), 1758.56 (Sonhat), and 1844.90 (Khadgawan).

Seed viability and seed germination

% seed germination of *Cyperus iria* ranged between 33.51 to 36.14% among the four studied sites. % seed germination ranged between 34.66 to 37.86% among four studied sites for *Cyperus flavidus*. % seed germination ranged between 55.44 to 60.39% for *Echinochloa colona*. Highest % germination were recorded by *Echinochloa colona*. Highest seed viability were recorded by *Cyperus flavidus* in Sonehat and Manendragarh site. The seeds of *Cyperus iria* were found to be least viable for all the study sites.

Growth Performance

Analysis of show that there was not any significant difference in the growth attributes of the weed plants at the four sites studied. The average height of the plant of *Cyperus iria* was 66.30±2.36 cm. and spread was 28.55±1.55 cm. Root penetration was 3.47±0.216 cm. Average shoot/root dry weight ratio was 5.35±0.376 gm although it was reported maximum i.e. 6.00 gm at Sonhat site. Maximum shoot height was observed at Manendragarh site for *C. iria*, but it was maximum at Khadgawan site for *E. colona*. Maximum height of *C. flavidus* was observed at Baikunthpur.

Table 2: Correlation Study between various eco-physiological attributes of *Cyperus iria*

	Seed Size	**Seed Weight**	**Reproductive Capacity**	**Germination (%)**	**% Viability**
Seed Size	0	0.51023	0.54209	0.049318	0.60383
Seed Weight	-0.48977	0	0.0094468	0.26412	0.026816
Reproductive Capacity	0.45791	-0.99055	0	0.29361	0.061259
Germination (%)	0.95068	-0.73588	0.70639	0	0.34414
% Viability	0.39617	-0.97318	0.93874	0.65586	0

Table 3: Correlation Study between various eco-physiological attributes of *Cyperus flavidus*

	Seed Size	**Seed Weight**	**Reproductive Capacity**	**Germination (%)**	**% Viability**
Seed Size	0	0.10378	0.3054	0.79389	0.37647
Seed Weight	-0.89622	0	0.32674	0.46951	0.56055
Reproductive Capacity	0.6946	-0.67326	0	0.34747	0.076342
Germination (%)	0.20611	-0.53049	0.65253	0	0.64696
% Viability	0.62353	-0.43945	0.92366	0.35304	0

Table 4: Correlation Study between various eco-physiological attributes of *Echinochloa colona*

	Seed Size	Seed Weight	Reproductive Capacity	Germination (%)	% Viability
Seed Size	0	0.80104	0.24805	0.45955	0.061073
Seed Weight	0.19896	0	0.59351	0.087206	0.77794
Reproductive Capacity	0.75195	-0.40649	0	0.87942	0.42922
Germination (%)	-0.54045	-0.91279	0.12058	0	0.40108
% Viability	-0.93893	-0.22206	-0.57078	0.59892	0

Correlation study among the various Eco-physiological parameters of three studied weed species reflects significant positive correlation. In case of *Cyperus iria* seed size was significantly and positively correlated with % viability and % germination at 5% level of significance. Again percentage germination was found to be positively correlated with reproductive capacity for the same species. (Table-2) Seed size was found to be positively correlated with percentage germination, reproductive capacity and percentage viability of seeds at 5% level for *Cyperus flavidus*. Reproductive capacity was found to be positively and significantly correlated with percentage germination and percentage viability of seeds of the concerned weed species. (Table-3) In case of *Echinochloa colona* seed size was positively correlated with seed weight. Seed weight was found to be positively correlated with percentage viability. Reproductive capacity was found to be positively correlated with percentage of germination (Table-4)

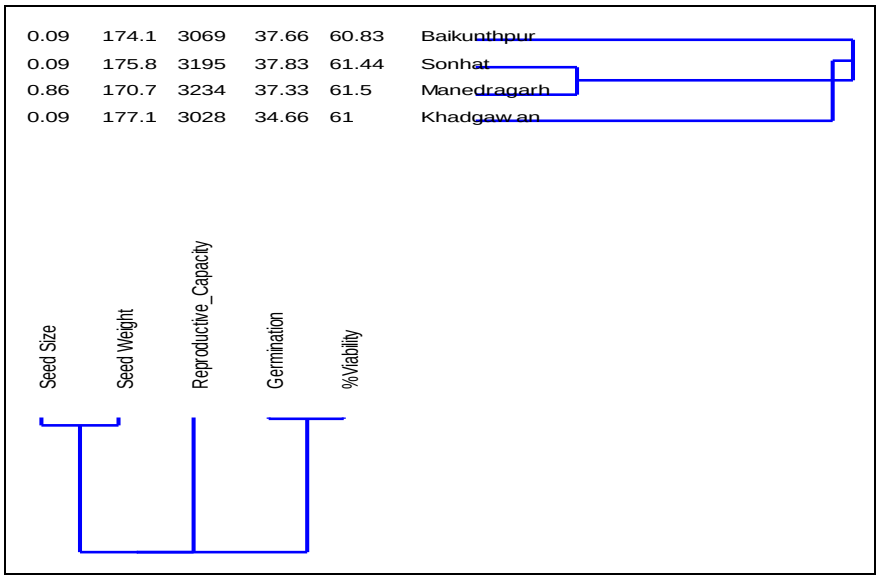

Fig 1: Cluster analysis of ecophysiological attributes of *Cyperus flavidus*

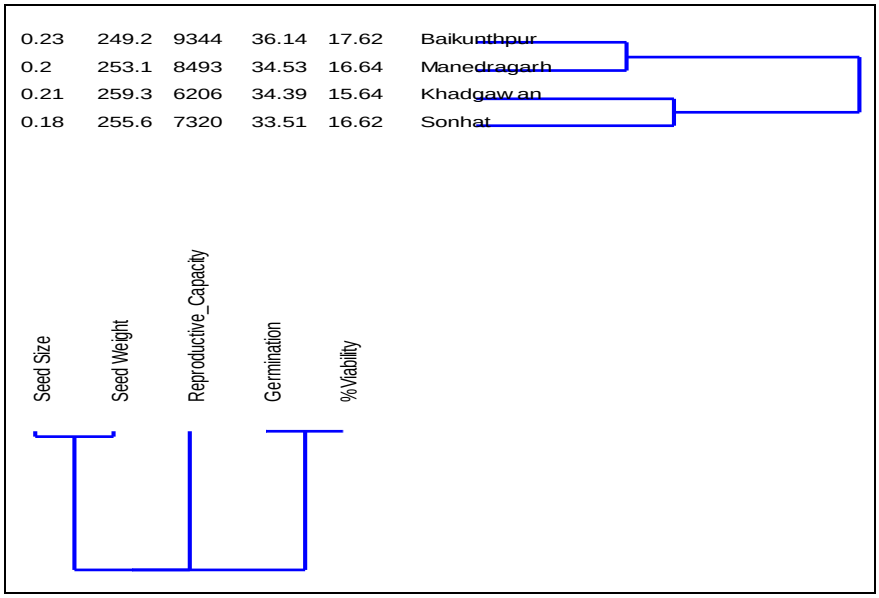

Fig 2: Cluster analysis of eco-physiological attributes of *Cyperus iria*

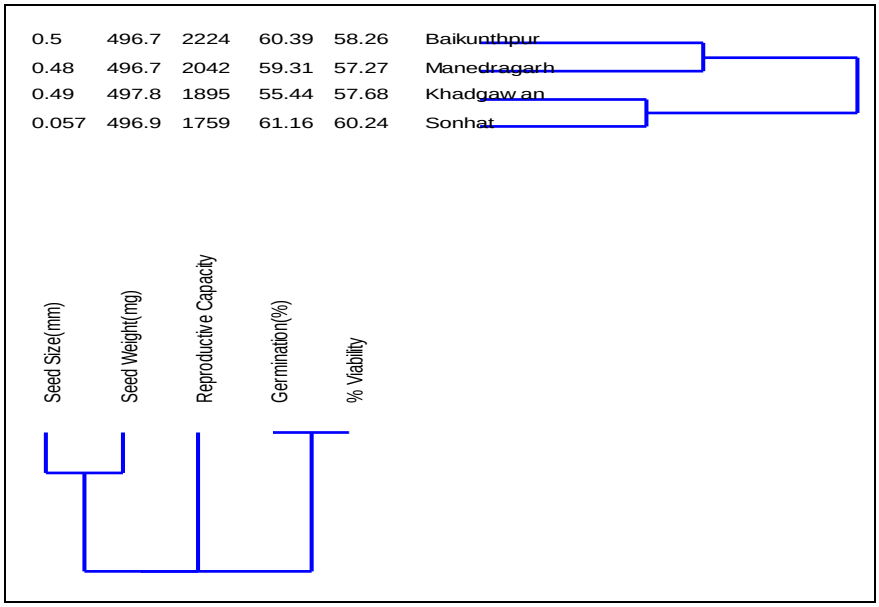

Fig 3: Cluster analysis of ecophysiological attributes of *Echinochloa colona*

Figure 1, 2 and 3 represents two way cluster analysis for the observed weed species during the present investigation. For *Cyperus flavidus* with respect to ecophysiological attributes Sonehat and Manendragarh were similar in nature forming small cluster. The other two sites formed distant cluster distant cluster. Among the various eco-physiological attributes of the concerned species seed size and seed weight formed closely space cluster. The other parameters formed distancely spaced cluster due to their heterogenous nature. In case of *Cyperus iria* Baikunthpur and Manendragarh as well as Khadgawan and Sonehat formed small clusters among themselves on the basis of various ecophysiological attributes. Seed size and seed weight along with percentage germination and percentage seed viability formed closely spaced cluster reflecting homogenous nature of the concerned variable for *Cyperus iria*. Similar nature of clustering data were observed for *Echinochloa colona*.

Discussion

Seed morphology denotes total effects of various stresses and strains which the species is subjected to, during its evolution in its specific habitat of origin. Seed characters actually originate due to interactions of various environmental conditions prevailing in the habitat of plant. Mayer and Mayber (1963) [18] observed that the size and shape of seeds is extremely variable depending on the forms of ovary, the condition under which the plant is growing during seed germination and obviously on the species. The seeds of *Cyperus iria*, *Cyperus flavidus*, and *Echinochloa colona* are very small in size. Very small size and specific shape of seeds perhaps helps in the dispersal. This may be the reason behind their wide spread distribution throughout the paddy fields.

Seed weight gives a rough approximation of the supply of potential energy available to seedling. This also gives an idea of food reserve available to the embryo for its growth and development in absence of suitable environmental conditions at its early stage. (Misra, 1968) [20] The seeds of the three dominating weeds were light in weight. Their light weight seems to facilitate their wide dispersal along the rice fields.

The seed output is the total number of seeds produced by a plant in one season. This represents the capacity of perpetuation of the species.

Grasses are reported to have a high level of seed output. They also show a reproductive capacity of a high order. This was also observed in the present study. High seed output and reproductive capacity of the weeds during present study clearly indicate that they have good amount of intrinsic capacity to increase in their number in time, provided the ecological factors are favourable. Success of any particular species depends on its reproductive capacity.

Germination is the transition from seed to seedling and it is the most critical stage in the development of a plant. The observations on germination experiments show that *Echinochloa colona* exhibited maximum percentage germination in 2009 cropping season. However, it was less as compared to viability of the seeds. This fact may be attributed to the various environmental factors responsible for germination and seedling mortality of the plant.

The small sized seeds of the *Cyperus iria*, *Cyperus flavidus* and *Echinochloa colona* were very light in weight, showing a large seed output and high reproductive capacity. Holm *et al*. (1977) [13] emphasized the ability of weeds to compete with the crop. These weeds seem to allocate a large proportion of resources to seed production. Thus, these three annual species of weeds appear to fit in the category of "Competitive Ruderals" according to Grime's (1979) concept of plant strategies and resource allocation. He considered that plants having competitive ruderal strategy are characterized by high plasticity in vegetative growth, rapid early growth rates, and a prolonged vegetative phase prior to and during reproduction. The results in the present study also support the previous findings of Ramkrishnan and Khosla (1959) [24], Shukla (1977) [32], and Mishra (2008).

Freshly collected seeds of *Echinochloa colona* showed post-harvest dormancy which started germinating after a storage of four to six months. The seeds collected in the month of

November showed almost 50% viability. Percentage germination was approximately 16% less as compared to viability in all the study sites. This was unique and was not reported in earlier literature. The difference in seed, shape, volume and weight of seeds plays an important role in modifying seed germination (Keddy and Constable, 1986) [16]. There are many reports that polymorphic seeds differ in their germination require-ments (Williams and Hampar, 1965; Burris *et al*., 1971; Lahiri and Kherbanda, 1961; Shukla, 1977; Misra, 2008) [21, 32, 36, 17].

Conclusion

From the results it can be concluded that *Echinochloa colona* has the highest probability to spread on the different study sites due to their higher germination percentage as well as higher percentage of seed viability. *Cyperus iria* although having higher reproductive capacity may not flourish as *Echinochloa colona* due to their low germination percentage as well as seed viability.

In a sustainable agriculture system, it is both economically and environmentally desirable to develop management strategies based on a more detailed understanding on the weed's ecology and physiology. Also, it is critical to know the factors, resources and means that regulate changes in the population size and dynamics of an individual weed species. Such knowledge can add important information to help to determine their potential for occurrence and abundance in certain microhabitats and also could help predict if such species are on the verge of massive range extensions. Ultimately these information may also aid in the improvement of the weed management strategies and development of novel control practices.

References

1. Burris J.S. Effect of seed size on seedling performance in soyabeans. I. Seedling growth and respiration. Crop Sci. 1971; 2:442-445.
2. Camper ND. Research methods in Weed Science. 3rd Ed. SWSS, America, 1986.
3. Chakraborty AK. Weed flora of paddy fields of West Bengal. Ind. Agri. 1967; 1:19-26.
4. Datta PC, Maiti RK. Paddy field weeds of Midnapore district. Economic Botany. 1983; 7:147-166.
5. Datta SC, Banerjee. Useful weeds of West Bengal rice fields. Economic Botany. 1978; 32:297-310.
6. De Dutta SK, Bernasov PC. Selectivity of some new herbicides for direct seeded flooded rice in tropics. Weed. Res. 1971; 11:41-46.
7. Deshmukh LS, Jadhav AS, Raskar SK. Weed management through post emergence and low doze herbicides. Agrobiose Newsletter. 2007; VI(2):37-39.
8. Grime JP. Plant Strategies and Vegetation Processes. Wiley, New York, 1979.
9. Goodall DM. Quantitative method for the classification of vegetation. The use of positive interspecific correlation. Aust. J Bot. 1952; 1:39-63.
10. Ghorai AK, De RK, Pandit NC, Mandal RK, Chakraborty AK. Biological control of *Cyperus rotundus* L. by *Fusarium oxysporum*. Indian J Weed Sc. 2005; 37(1&2):142-143.
11. Harper JL. Population Biology of plants. Academic Press, London, 1977.
12. Holt JS. Ecological and Physiological characteristics of weeds In: Altieri M.A. & Liebman, M. (eds.). Weed management in Agroecosystems: ecological approaches, CRC Press, Boca Raton. 1988, 7-23.
13. Holm L, Plunknett DL, Pancho JV, Herberger. The World's Worst Weeds Distribution and Biology. University Press of Hawaii, Honolulu, 1977.
14. Kaul VN. Physico-ecological studies of *Xanthium strumarium* and *Croton sparsiflora*. Ph.D. Thesis, Banaras Hindu University, Varanasi, 1959.
15. Khare A, Shrivastava SP, Singh PK. Weed flora of paddy crop of Banda district. Flora and Fauna. 2004; 10(1):15-18.
16. Keddy PA, Constable P. Germination of tan. Shoreline plants in relation to seed size, soil particle size, and water level: An experimental study. J Ecol. 1986; 74:133-142:3-24.
17. Lahiri AN, Kharbanda BC. Dimorphic seeds in some arid grasses and the significance of growth differences in their seedlings. Sci. & Cult. 1961; 27:448.
18. Mayer AN, Mayer AP. The Germination of Seeds. Pergamon Press. London, 1963.
19. Misra R, Shiva Rao BS. A study in the autecology of *Lindenbergia polyantha* Royle. Journ Ind. Bot. Soc. 1948; 27:186-99.
20. Misra R. *Ecology Workbook*. Oxford IBH Pub. Co. New Delhi, 1968.
21. Misra S. Ecophysiological studies of *Sida cordifolia* L. With special reference to its cultivation and marketing value. Ph.D. Thesis A.P.S. University, Rewa, M.P, 2008..
22. Oudhia P, Dixit A. Weeds in Ambikapur region (Madhya Pradesh) and their traditional uses. Weed News. 1994; 1(2):19-21.
23. Pathak T. Ecophysiological studies of some weeds with special reference to *Commelina benghalensis*. Ph.D. Thesis. University of Saugor, Sagar (M.P.), 1981.
24. Ramkrishnan PS, Khosla AK. Seed dormancy in Digitaria adacandens and Echinochloa colonum with reference to covering structure. Proc. Ind. Acad. Sci. 1971; 2:112-122.
25. Rais Shabnam. Certin morphological and ecophysiological studies on *Datura innoxia* Mill. Ph.D. thesis. A.P.S. university, Rewa, 1992.
26. Rao AN, Dagar JC, Dubey PS. Phyto-allelopathic potentials of *P. hysterophorus* Linn. Ind. J Weed Sci. 1977; 9(1):24-30.
27. Radosevich SR, Holt JS. Weed ecology: Implications for vegetation management. John Wiley and Sons In C. New York, 1984.
28. Salisbury EJ. The geographical distribution of plants in relation to climatic factors. Geo. Journ. 1926; 67.
29. Salisbury EJ. Reproductive Capacity of Plants. G. Bell & Sons. 1942, 247.
30. Salisbury EJ. The weed problem of Royal Inst. of Great Britain, Afternoon Lecture. 1942a, 15.
31. Salisbury EJ, Gupta JK. Phytosociological studies on weed competing with barley (*Hordeum vulgare*) crop. Indian J Ecol. 1982; 9:59-63.
32. Shukla AP. Studies in the autecology and physiology of

Paspalam scrobiculatum L. Ph.D. Thesis, A.P.S. University, Rewa, 1977.
33. Singh V, Gupta S., Singh H, Singh A. Raghubanshi Ecophysiological characteristics of five weeds and a wheat crop in the Indo-Gangetic Plains, India. Journal of weeds Biology and management 2015; 15(3):102-112.
34. Tiwari A, Sahu PK, Shrivastava AK, Thomas M. Plant diversity and distribution of weeds in winter season crops of agroecosystems in Bilaspur district, Chhattisgarh. Journal of Biodiversity and Environmental Sciences (JBES) 2014; 5(2):251-259.
35. Thakur D. Ecophysiological studies of *Hyptis suaveolens* Poit. Ph.D. Thesis; A.P.S. University, Rewa, 1992.
36. Williams, Hamper JL. Seed polymorphism and germination I. The influence of nitrates and low temperature on germination of *Chenopodium album*. Weed Res. 1965; 191:150.
37. Wilson RG. Biology of weed seeds in soil In: ALTIERI MA. & LIEBMAN, M. (eds.) Weed management in Agroecosystems: ecological approaches, CRC Press, Boca Raton. 1988, 25-39.