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## RESEARCH ARTICLE

# IDENTIFICATION AND COMPARISON OF CHEMICAL PROFILING OF SOME CROPS AND WEEDS AT SEEDLINGS STAGE IN THE FIELDS OF BALURGHAT BLOCK, DAKSHIN DINAJPUR, WEST BENGAL

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**ABSTRACT**

Seedlings of eight weeds and seven crops are described and quantitatively analyzed with six chemical parameters viz. leaf extract pH, ascorbic acid contents, total chlorophyll content, protein content, total phenolic content and peroxidase activity. Morphological traits of seedlings of both crops and weeds are used for the preparation of artificial keys separately for their proper identification. Of many chemical parameters, only these six parameters may address towards better adaptation of weeds and crops to the stressful environment. However, very little differences have been resulted in the above chemical parameters under numerical analysis through ANOVA and Principal component analysis.

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# INTRODUCTION

Weeds are undesired plant species that grow with cultivated crops and intervene or compete with the crops for growth and nutrients, and in this way affect productivity leading to economic loss (Marwart *et. al.* 2013). Since, number of seed production, seed production rate, seed viability and resistance to the environment are higher in weeds compared to crops, vigorous germination of seeds occurs during pre or post-harvest periods establishing abundant seedlings. Even the occurrence of flowering can be observed in these weeds at the seedling stage indicating their partly ephemeral behavior. This makes it a lot of harder for their total eradication from the field because they immediately disperse innumerable seeds. However, eradication at the seedling stage minimizes the chance of further weed dispersal by limiting their life cycle before flowering. There are, however, relatively few previous publications dealing with weed seedling identification (Kumar, 1951; Chancellor, 1959; Singh, 1963; Stucky, 1984; Singh and Singh, 1994; Bhattacharya and Paria, 1996; Anonymous, 2008; Singh and Sahu, 2010; Singh *et. al*., 2011; Singh and Sahu, 2012; Parkinson, 2013; Singh, 2015 and Das and Kamilya, 2020). Secondary metabolites apparently act as defense (against herbivores, microbes, viruses, or competing plants) and signal compounds (to attract pollinating or seed-dispersing animals), as well as protecting the plant from several biotic and abiotic stressors (Chon *et. al.,* 2002; Tegelberg *et. al.,* 2004) from the beginning of their life cycle. Studies on Australian Proteaceae (Hanley and Lamont, 2002) provide evidence that high leaf phenolic contents and antioxidants deter herbivores as well as abiotic stressors. These phenolic compounds as well as other primary or secondary metabolites may have highly diverse biological activities. Usually, it has been seen that survival abilities and regeneration capabilities of some weeds are greater as compared to many crops even under unfavorable environments. Considering the stress enduring capacity of majority of weeds, some chemical parameters are adopted experimentally at the juvenile stages which are hardly

considered earlier. A strategy for the quantitative analysis of a few metabolites in some weed and crop seedlings has been considered in the present studies to observe whether any significant variation is present or not in both. This may help to analyze the weed seedlings as good markers for biotic or abiotic stresses.

# MATERIALS AND METHODS

For the survey of crop field weeds, the present study was conducted in the different mouza of Balurghat Block, situated in Dakshin Dinajpur district of West Bengal, India during the year 2018-2019 respectively. This block is situated on the banks of Atrai River and its latitude and longitude is 25.2373° N, 88.7831° E. Here, the climate is portrayed by hot and moist in summer, plentiful rain in monsoon, cool and comfortable in winter. This block have characterized predominantly with alluvium soil which has facilitated for double and multi cropping. Seeds and seedlings of eight problem weeds *i.e., Mollugo hirta, Polycarpon prostratum, Ageratum houstonianum, Phyllanthus fraternus, Chenopodium album, Rumex dentatus, Solanum nigrum,* and *Leucas aspera* were collected in seven fields of common rabi crops like *Phaseolus aureus, Brassica campestris, Brassica oleracea, Amaranthus viridis, Amaranthus gangeticus, Raphanus sativus,* and *Momordica charantia*. The seedlings of above crops were also collected by permission of farmers. All seedlings were collected at 4-6 leaved stages. The seeds of crops were sown in separate seedbeds along with dried seeds of all eight weeds to raise the seedlings.

The so-raised seedlings were collected at 4-6 leaved stage for both crops and weeds. The live seedlings were usually collected during morning time (8 A.M. to 10 A.M) and sent to the laboratory of applied stress biology, Department of Botany, University of Gour Banga at the same day for biochemical profiling. The seedlings of both were dried and made herbarium sheets which were deposited in the herbarium of Balurghat College for documentation. The fresh seedlings are described following parameters considering the literatures of Duke, 1969; Burger, 1972; deVogel, 1980; Paria *et. al*., 2006; Das and Kamilya, 2014; Singh, 2015; Das and Kamilya, 2020. Artificial keys are prepared separately for crops and weeds for identification at seedling stage. Author citations are given providing proper protologue references. The taxa are arranged alphabetically. The chemical analysis of both weeds and crop seedlings at 4-6 leaved stage (live specimen) has done following procedures of Maclachlan and Zalick, 1963 (for total photosynthetic pigments); Keller and Schwager, 1977 (for ascorbic acid content); Lowry *et. al*., 1951 (for protein content); Prasad and Rao, 1982 (with minor modification for leaf extract pH); Bray and Thorpe, 1954 (for total phenolic content) Britton and Mehley, 1955 (for peroxidase activity). One-way analysis of variance (ANOVA) was conducted to determine the significance of quantitative changes for studied parameters due to stress condition. Then, Duncan's multiple range test was applied as post hoc on parameters. The morphometric analysis was carried out through Principle component analysis (PCA) that was done by the Varimax rotated factor matrix method based on orthogonal rotation criterion with Kaiser's normalization. All the statistical tests were performed by SPSS software (SPSS Inc., version 16.0).

# RESULTS

**Systematic enumeration**

**Description &Artificial keys of seedlings**

Crop plants:

*Amaranthus gangeticus* L. Seedling phanerocotylar, epigeal. Hypocotyl angular, glabrous, light green. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, glabrous; blade lance-ovate, base cuneate, apex obtuse, margin entire; primary vein one, eucamptodromous. First two leaves alternate, simple, petiolate, exstipulate, herbaceous, glabrous; blade widely ovate, base truncate, apex emarginate, margin ± entire; primary vein one, eucamptodromous. Subsequent leaves same as first two leaves. Internodes ±angular, glabrous.

*Amaranthus viridis* L. Seedling phanerocotyler, epigeal. Hypocotyl terete, glabrous, purple. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, glabrous; blade-lanceolate, base attenuate, apex narrowly acute, margin entire; primary vein one, hyphodromous. First two leaves alternate, simple, petiolate, exstipulate, glabrous; blade ovate, base obtuse, apex emarginate, margin entire; primary vein one, camptodromous. Subsequent leaves same as first two leaves, purplish colour become more prominent abaxially. Internodes terete, 5-6 angular, glabrous.

*Brassica campestris* L. Seedling phanerocotylar, epigeal. Hypocotyl terete, glabrous. Paracotyledons two, opposite, exstipulate, petiolate, herbaceous, glabrous; blade obcordate, base obtuse to truncate, apex broadly notched emarginate, margin entire; primary veins three, secondary veins not forming loops, actinodromous. First two leaves alternate, simple, petiolate, exstipulate, pubescent; blade sinuate, base cuneate, apex acute to obtuse, margin broadly dentate; primary vein one, craspedodromous. Subsequent leaves lyrate to ovate, base cuneate, apex obtuse, margin irregularly dentate; primary vein one, craspedodromous. Internodes ±pentangular, pubescent.

*Brassica oleracea* L. Seedling phanerocotyler, epigeal. Hypocotyl terete, glabrous, purplish-green. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, glabrous; blade subreniform, base obtuse, apex deeply retuse, margin entire; primary veins five, acrodromous. First two leaves alternate, simple, exstipulate, petiolate, herbaceous, glabrous; blade ovate to elliptic, base obtuse to rounded, apex obtuse to rounded, margin dentate; primary vein one, craspedodromous. Subsequent leaves same like first two leaves. Internode angular, glabrous.

*Momordica charantia* L. Seedling phanerocotylar, epigeal. Hypocotyl square, hollow, glabrous. Paracotyledons two, opposite, petiolate, exstipulate, thick-fleshy, glabrous; blade oblong, base truncate, apex ± rounded, margin entire; primary vein one, hyphodromous. First two leaves opposite, simple, petiolate, exstipulate, herbaceous, pubescent; blade broadly cordate to peltate, base cordate, apex acute, margin broadly dentate; primary veins three, palinactinodromous (perfect,

marginal, suprabasal). Subsequent leaves alternate, ovately 5-lobed, base shallowly cordate, margin incised-dentate, primary veins five. Internodes ± hexangular, pubescent.

*Phaseolus aureus* Roxb. Seedling phanerocotylar, epigeal. Hypocotyl fistulose, 4-5 angular, pubescent, Paracotyledons two, opposite, sessile, thick-fleshy, herbaceous, glabrous; blade narrow-oblong, deciduous at 2-leaves stage, base truncate, apex obtuse, margin entire; primary vein one, inconspicuous, hyphodromous. First two leaves opposite, simple, petiolate, stipulate (interpetiolar), herbaceous, hairy (strigose); blade lance-ovate, base subtruncate, apex acute, margin entire; primary veins three, acrodromous (imperfect, basal). Subsequent leaves alternate, trifoliate (palmate-ternate), petiolate, stipulate (free lateral), herbaceous, pubescent green; blade ovate, base obtuse, apex acute, margin entire; primary veins three, actinodromous (reticulate, basal). Internodes hexangular, hollow, pubescent.

*Raphanus sativus* L. Seedling phanerocotylar, epigeal. Hypocotyl terete, glabrous, green to reddish-green, basally bulbous. Paracotyledons two, opposite, exstipulate, petiolate, herbaceous, glabrous; blade widely elliptic, base obtuse to truncate, apex widely emarginate, margin entire; primary veins three, secondary veins forming loops, actinodromous (perfect-reticulate, basal). First two leaves alternate, simple, exstipulate, petiolate, herbaceous, pubescent; blade lyrate to pinnatisect, base obtuse, apex acute, margin irregularly serrate; primary vein one, craspedodromous. Subsequent leaves same as first two leaves except base truncate, pinnatisect. Internode terete, pubescent.

**Key to the species (Key valid for the studied crop plants only):**

1a. First two leaves opposite…….....2
1b. First two leaves alternate..…….....3
2a. Paracotyledons sessile, deciduous at two leaves stages; first two leaves stipulate (interpetiolar), sub-sequent leaves compound (trifoliolate).....***Phaseolus aureus***
2b. Paracotyledons petiolate, persistent more than two leaves stages; first two leaves exstipulate, subsequent leaves simple, ovately 5-lobed to palmatisect……..…***Momordica charantia***
3a. Eophylls hairy (first two leaves and subsequent leaves)……..…4
3b. Eophylls glabrous……..……..……..……5
4a. Paracotyledons obcordate, secondary veins wide and not forming loop; first two leaves sinuate, hypocotyl base never swollen…….....***Brassica campestris***
4b. Paracotyledons widely elliptic, secondary veins forming loops; first two leaves irregularly serrate, fleshy swollen hypocotyls base distinct at 4-6 leaves stage...***Raphanus sativus***
5a. Eophyll margin entire, apex emarginate…….…..……....6
5b. Eophyll margin dentate, apex obtuse to rounded……..……..***Brassica oleracea***
6a. Paracotyledons lance-ovate; base of first two leaves truncate; internode angular; subsequent leaves greenish below…….……...….***Amaranthus gangeticus***
6b.Paracotyledons lanceolate, base of first two leaves obtuse; internode terete; subsequent leaves purplish beneath.…….……..……..***Amaranthus viridis***

**Weed plants:**

*Ageratum houstonianum* Mill. Seedling phanerocotylar, epigeal. Hypocotyl ± rounded, glabrous. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, hairy (scabrous); blade ovate, base cuneate, apex retuse, margin entire; primary vein one, hyphodromous. First two leaves opposite, simple, petiolate, exstipulate, herbaceous, hairy (pubescent); blade ovate, base broadly cuneate, apex obtuse, margin deeply serrate; primary veins three, acrodromous. Subsequent leaves same as first two leaves. Internodes ± rounded, hairy (hirsute).

*Chenopodium album* L. Seedling phanerocotylar, epigeal. Hypocotyl terete, minutely hairy (farinaceous). Paracotyledons two, opposite, petiolate, exstipulate, falcate, hairy (farinaceous); blade linear to narrowly oblong, base attenuate, apex obtuse, margin entire; primary vein one, hyphodromous. First two leaves alternate, simple, petiolate, exstipulate, coriaceous, hairy (farinaceous, glandular capitate); blade lanceolate to lance-ovate, base cuneate, apex narrowly acute to acute, margin entire; primary vein one, camptodromous. Subsequent leaves same as first two leaves. Internodes ± angular, surface hairy (farinaceous).

*Leucas aspera* (Willd.) Link. Seedling phanerocotylar, epigeal. Hypocotyl ± rounded, hairy (hirsute). Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, hairy (scabrous); blade oblong-rectangular, base broadly cuneate, apex rounded, margin entire; primary vein one, hyphodromous. First two leaves opposite, simple, petiolate, exstipulate, herbaceous, hairy (pubescent); blade narrowly elliptic, base attenuate, apex acute, margin serrate; primary vein one, camptodromous. Subsequent leaves same as first two leaves. Internodes tetrangular, hairy (pubescent).

*Mollugo hirta* Thunb. Seedling phanerocotylar, epigeal. Hypocotyl ± rounded, glabrous. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, glabrous; blade sub or broadly ovate, base cuneate, apex obtuse, margin entire; primary vein one, hyphodromous. First two leaves alternate, simple, petiolate, stipulate (free lateral, caducous), herbaceous, minutely hairy (stellate to tomentose); blade ovate to elliptic, base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. Subsequent leaves alternate to falsely whorled with camptodromous venation, other characters same as first two leaves. Internodes ± angular, hairy (stellate, tomentose).

*Phyllanthus fraternus* G. L. Webster. Seedling phanerocotylar, epigeal. Hypocotyl terete, glabrous. Paracotyledons two, opposite, petiolate, herbaceous, glabrous; blade narrowly oblong, base cuneate, apex rounded, margin entire; primary vein one, hyphodromous. First two leaves alternate, simple, petiolate, stipulate (free lateral), herbaceous, glabrous; blade elliptic to obovate, base acute, apex rounded, margin entire; primary vein one, hyphodromous. Subsequent leaves oblong with camptodromous venation, other characters almost similar to first two leaves. Internodes round to oval, glabrous.

*Polycarpon prostratum* (Forssk.) Asch. & Schweinf. Seedling phanerocotylar, epigeal. Hypocotyl tetrangular, glabrous. Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, glabrous; blade ovate to elliptic, base subrounded, apex subrounded, margin entire; primary vein one, hyphodromous. First two leaves opposite, simple, petiolate, exstipulate, herbaceous, glabrous; blade oblate, base cuneate, apex subrounded, margin entire; primary vein one, hyphodromous. Subsequent leaves faint camptodromous venation, other character same as first two leaves. Internodes square, hairy (tomentose).

*Rumex dentatus* L. Seedling type phanerocotylar, epigeal. Hypocotyl terete, glabrous. Paracotyledons two, opposite, petiolate, stipulate (ochreate), herbaceous, hairy (glandular, papillate); blade narrowly oblong, base cuneate, apex obtuse, margin entire; primary vein one, hyphodromous. First two leaves alternate, simple, petiolate, stipulate (ochreate, membranous), herbaceous, hairy (glandular); blade ovate-oblong to ovate, base sub-truncate, apex obtuse, margin entire; primary vein one, camptodromous. Subsequent leaves oblong with repand margin, other characters same as first two leaves except slightly toothed margin. Internodes rounded, glabrous.

*Solanum nigrum* L. Seedling type phanerocotylar, epigeal. Hypocotyl terete, hairy (pubescent). Paracotyledons two, opposite, petiolate, exstipulate, herbaceous, sparsely hairy (pubescent, simple glandular); blade lanceolate, base cuneate, apex acute, margin entire to slightly wavy; primary vein one, hyphodromous. First two leaves alternate (spiral), simple, petiolate, exstipulate, herbaceous, hairy (pubescent); blade ovate, base oblique, apex obtuse, margin entire; primary vein one, camptodromous. Subsequent leaves almost similar to first two leaves. Internodes slightly angular, hairy (pubscent).

**Key to the species: (Key valid for the studied weeds only)**

1a. First two leaves opposite….....2
1b. First two leaves alternate…….....……3
2a.Venation of first two leaves camptodromous, blade narrowly elliptic…..... ***Leucas aspera***
2b.Venation of first two leaves hyphodromous or acrodromous, blade ovate or oblate……4
3a. First two leaves with one primary vein and hyphodromous venation, blade oblate; paracotyledon base rounded…….……..……***Polycarpon prostratum***
3b.First two leaves with three primary veins and acrodromous venation, blade ovate; paracotyledon base cuneate…….....***Ageratum houstonianum***
4a.First two leaves exstipulate……..5
4b.First two leaves stipulate…….……6
5a. Paracotyledon falcate; first two leaves with farinaceous glandular-capitate hairs, base cuneate....***Chenopodium album***
5b. Paracotyledon lanceolate, first two leaves with pubescent hairs, base unequal…….....***Solanum nigrum***
6a.Stipule caduceus; subsequent leaves alternate to falsely whorled….....***Mollugo hirta***
6b.Stipule persistent; subsequent leaves alternate always…….....7
7a.First two leaves with thin membranous ochreate stipules, venation camptodromous….....***Rumex dentatus***
7b. First two leaves with free lateral stipules, venation hyphodromous…..... ***Phyllanthus fraternus***

Maximum leaf extract pH was observed in the seedlings of *Amaranthus viridis* (7.21 ± 0.53) whereas, minimum was found in *Raphanus sativus* seedlings (6.01± 0.44) among all the crops seedlings during the study periods. But, the highest pH value was shown by *Polycarpon prostratum* (7.45 ± 0.55) and lowest pH value by *Rumex dentatus* (6.41 ± 0.47) among all the weeds seedlings. According to one - way ANOVA results, non-significant variation observed among leaf extract pH of all crops and weeds seedlings (Figure 1). The average maximum and minimum total chlorophyll content (Tchl) was found in *Brassica campestris* (2.51 ± 0.18 $mg.g^{-1}$) and in *Amaranthus viridis* (0.64 ± 0.04 $mg.g^{-1}$) respectively among the all crops. But, *Chenopodium album* seedlings showed the highest mean total chlorophyll content (2.64 ± 0.19 $mg.g^{-1}$) and *Ageratum houstonianum* exhibited the lowest mean total cholorophyll content (0.10 ± 0.007 $mg.g^{-1}$) among the all studied weed seedlings. One - way ANOVA results showed that Tchl of *Brassica campestris* and *Chenopodium album* seedlings recorded significant variation with the other examined crops and weeds seedlings Tchl (Figure 1). The average concentration of ascorbic acid content (ASC) ranged from 2.67 ± 0.19 to 2.74 ± 0.20 mg $g^{-1}$ and recorded as highest (2.74 ± 0.20 $mg.g^{-1}$) in *Brassica oleracea* and lowest in *Phaseolus aureus* seedlings (2.67 ± 0.19 $mg.g^{-1}$) respectively. But, the maximum value of ascorbic acid content observed in *Solanum nigrum* (2.74 ± 0.20 mg $g^{-1}$) followed by *Leucas aspera* (2.73 ± 0.20 $mg.g^{-1}$) and minimum in *Mollugo hirta and Phyllanthus fraternus* (2.68 ± 0.19 mg $g^{-1}$) respectively among all the studied weeds seedlings. One-way-ANOVA result depicted non-significant variation among the ASC of all studied crops and weeds seedlings (Figure 1). The total Phenolic content was highest in the seedlings of *Amaranthus gangeticus* (1.05 ± 0.07 mg $g^{-1}$) and *Mollugo hirta* (1.39 ± 0.10 mg $g^{-1}$) but, lowest in *Raphanus sativus* (0.54 ± 0.04 mg $g^{-1}$) and *Polycarpon prostratum* seedlings (0.31± 0.02 mg $g^{-1}$) among all the crops and weeds seedlings during the study periods.

One-way ANOVA results revealed that the total phenolic content of *Amaranthus gangeticus* seedlings showed significant variation with the total phenolic content of *Momordica charantia*, *Phaseolus aureus*, and *Amaranthus viridis* but, exhibited non- significant variation with the total phenolic content of *Brassica campestris* and *Brassica oleracea* seedlings (Figure 1). Among all the crops and weeds seedlings, protein content recorded as highest in *Phaseolus aureus* (0.31± 0.02 mg $g^{-1}$) and *Solanum nigrum* (0.30 ± 0.02 mg $g^{-1}$) seedlings. One – way-ANOVA results represented that the protein content of *Phaseolus aureus* seedlings exhibited significant variation with the protein content of all crops seedlings and also *Solanum nigrum* seedlings showed significant variation with the all weeds seedlings protein content (Figure 1). Peroxidase activity was maximum in *Phaseolus aureus* (0.15 ± 0.01 µM pur. formed $min^{-1}mg^{-1}$) seedlings as compared to the rest of crops seedlings. But, it was highest in *Mollugo hirta* (0.12 ± 0.009 µM pur. formed $min^{-1}mg^{-1}$) than others studied weeds seedlings.

According to One – way-ANOVA results, peroxidase activity showed non-significant variation with the peroxidase activity of *Momordica charantia* and *Amaranthus gangeticus* seedlings but showed significant variation with rest of crops seedlings (*Brassica campestris*, *Brassica oleracea*, *Amaranthus viridis*, and *Raphanus sativus*) peroxidase activity. In case of weeds seedlings, one – way-ANOVA results depicted that, peroxidase activity of *Mollugo hirta* seedlings showed significant variation with all the studied weeds seedlings peroxidase activity (Figure 1).Based on Principal component analysis (PCA), the accumulation percentage of variance was 99.77 where component 1 and component 2 showed 53.03% and 46.74 % variance respectively. PCA results revealed a maximum association among all the seedlings of crops and weeds in case of component 1 that indicated all studied parameters values of these seedlings were also very close. The two highest value of rotated component matrix for component 1 was observed in *Polycarpon prostratum* and *Amaranthus viridis* which were 0.832 and 0.796 respectively (Figure 2).

# DISCUSSION

Seedling parameters are used for making artificial keys for seven crops and eight weeds. All seedlings are studied up to adult stages *i.e.* subsequent leaves and internodes. But quantitative analysis for six bio-chemical parameters has been considered at 4-6 leaved stage which are hardly considered earlier. Artificial keys for both crops and weeds are helpful for field identification. Rapid and accurate weed identification at seedling stage may be first step towards a successful weed management program (Parkinson *et. al.*, 2013) because most of the weeds are effectively controlled at a very young stage, so it is important to identify them as early as possible (Chomas *et. al.*, 2001) because weeds take more nutrients from the soils and reduce the crop productivity. .

The composite graphs of all six chemical parameters (through ANOVA) of crops and weeds show a little comparison. Ascorbic acid contents of both shows no differences. Little differences have been observed in leaf extract pH due to competition. But very few significant differences in other four chemical parameters have been shown. Protein contents in *Phaseolus aureus* and *Solanum nigrum* are higher than others. Total phenolic contents in *Rumex dentatus*, *Chenopodium album*, and *Mollugo hirta* show significant differences with crops.

This result was similar with the previous study of Ghosh *et. al.* (2016), stating that protein and phenolic contents reduce among crops; but, increase in weeds due to their competition. Peroxidase activity is somewhat higher in crops than weeds. It might be happen due to competition among crops and weeds for surviving at the same fields (Ghosh *et. al.*, 2016).

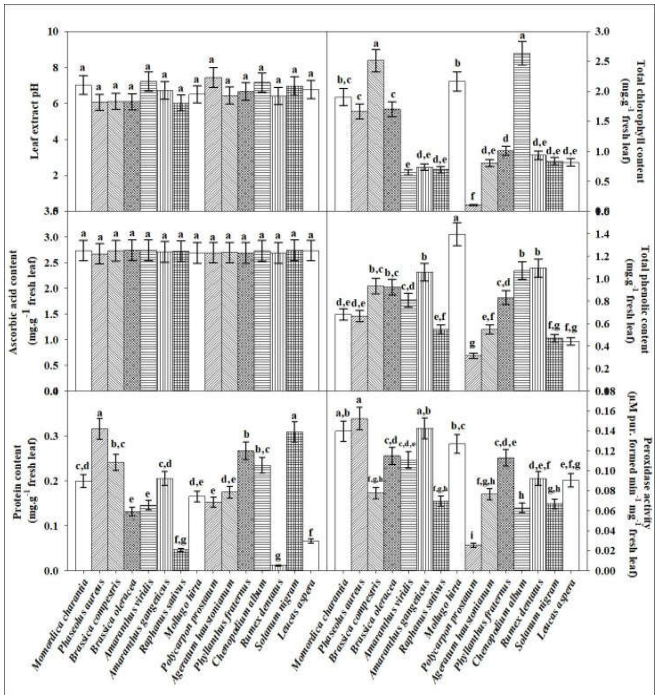


**Figure 1. Different analyzed biochemical parameters of examined crops and weeds seedlings, collected from different mouza of Balurghat block. Values represent mean ± SE. Bars showing different letters indicate variation according to Duncan's test at p < 0.05.**

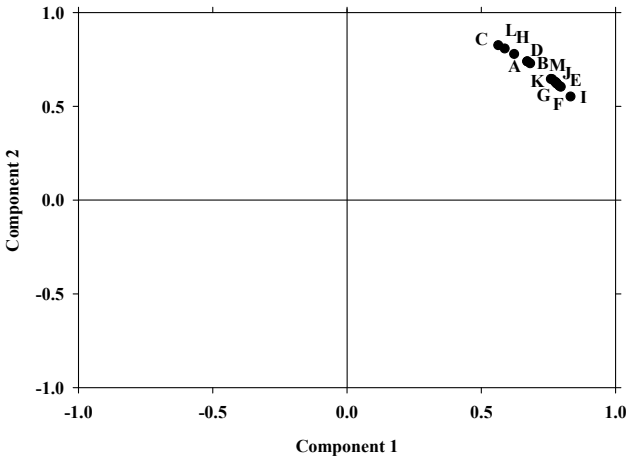


**Figure 2 Principle Component Analysis (PCA) showed association of both crops and weeds seedlings on two different components; *i.e.* component 1 and component 2 based on studied parameters such as leaf extract $P^H$, Tchl, ASC, total phenolic content, protein content and, peroxidase activity [ A = *Momordica charantia*; B = *Phaseolus aureus*; C = *Brassica campestris*; D = *Brassica oleracea*; E = *Amaranthus viridis*; F = *Amaranthus gangeticus*; G = *Raphanus sativus*; H = *Mollugo hirta*; I = *Polycarpon prostratum*; J = *Ageratum houstonianum*; K = *Phyllanthus fraternus*; L = *Chenopodium album*; M = *Rumex dentatus*; N = *Solanum nigrum**; O = *Leucas aspera**; * = not visible due to overlapping nature of characters].**

Similarly, total chlorophyll contents of *Chenopodium album* and *Mollugo hirta* have visible differences except *Brassica campestris*. Therefore, some weeds like *Mollugo hirta, Chenopodium album, Solanum nigrum, Rumex dentatus* have the possible greater potentiality of survival in the crop field than others due to presence of higher total chlorophyll content. These investigations are in close agreement with previously reported results of Ghosh *et. al.* (2016), reporting that total chlorophyll contents decrease among crops; but, enhance among weeds due to their competition. Similarly, few crops like *Momordica charantia, Phaseolus aureus* and *Brassica campestris* may have better survival ability than others. But extensive studies on other chemical parameters are essential to get a fruitful result for the potentiality of survival ability of crops and weeds at the seedling stage. PCA analysis using quantitative traits shows all weed and crop taxa are positively correlated. Since they show little differences in the treated chemical parameters, therefore, they may not be strongly addressed as biotic or abiotic stressors in the environment.

# CONCLUSION

Of many problem weeds, only eight are considered for comparison with their chemical parameters at seedling stage. For weed management, as an additional way, seedling stage is crucial. Crop seedlings are also important for proper identification if they are purchased from any source. Therefore, description at seedling stages and their identification by artificial key are very much significant for crop-weed interaction. Chemical profiling is also significant since it may be one of the markers to assess the fitness of weeds and crops in stressful environments. In the adult stage, the weeds show more regeneration capacity than crops due to their more significant chemical differences. However, in the seedling stage, both crops and weeds show very little differences, hence

they depict almost parallel behavior in stresses as evident from ANOVA and PCA analysis.

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