RESEARCH ARTICLE

*The Journal of Agriculture and Environment, Vol: 24, June, 2023 | (205-217)*

# PHYTOCHEMICAL SCREENING AND ALLELOPATHIC POTENTIAL OF IMPORTANT MEDICINAL PLANTS USED BY DHIMAL COMMUNITY IN URLABARI MUNICIPALITY

**Sonika Poudel [1,*] and Subodh Khanal [2]**

[1] Institute of Agriculture and Animal Science, Tribhuvan University, Kathmandu, Nepal

[2] Gauradaha Agriculture Campus, Institute of Agriculture and Animal Science, Tribhuvan University, Gauradaha, Jhapa

**ARTICLE INFO**

***Keywords:***

*Ailment,*

*ethnobotanicals,*

*fidelity level,*

*inhibition,*

*plumule,*

*radicle*

*Correspondence:

poudelsonika07@gmail.com;

Tel: +977-9817316046

**ABSTRACT**

*A study was conducted to document the major ethnobotanicals used against different ailments from Dhimal community of Urlabari Municipality. Deductive research approach employed through household survey using semi-structured questionnaire with 115 respondents for research work. Out of 23 documented plants, Cuscuta reflexa Roxb., Mimosa pudica L. , Azadirachta indica A. Juss, Achyranthes aspera L. and Acorus calamus L. were screened for further phytochemical analysis based on fidelity level. Five treatments maintained as 3 different concentrations (5, 10, and 15% of stock solution), and control were arranged in a completely randomized design with three replications for evaluating allelopathic potential where selected botanical extracts on germination, radical, and plumule growth of wheat seedlings were examined under invitro condition. Mimosa pudica L. had the highest alkaloid (15.39%), Cuscuta reflexa Roxb. had the highest terpenoid (9.17%) and Acorus calamus L. had the highest saponin (5.49%) when calculated via gravimetric method. Germination, radical and plumule growth found under control treatment were $3.24^{ab}$±0.09, $2.94^{a}$ ±0.09cm and $2.70^{a}$ ±0.17cm respectively. The stock solution of Acorus calamus L. with 15% concentration extract resulted in the maximum reduction of radicle length ($1.14^{e}$±0.22cm) and plumule length ($1.04^{h}$±0.17cm), along with heavily controlled germination ($1.05^{f}$±0.17) of wheat seedlings. Thus, Acorus calamus L. proved the highest allelopathic potential on wheat seedling growth indicating further investigation on other crops.*

## 1. INTRODUCTION

Nepal is a multi-ethnic, multi-lingual and multi-religious nation with each ethnic communities having significant customary knowledge on utilization of plant and plant parts and there is a long tradition of transferring this indigenous knowledge from generation to generation (Acharya & Acharya, 2009). The ethnic people residing in different geographical belts of Nepal depend on wild plants to meet their basic requirements and all the ethnic communities have their own pool of secret ethnomedicinal and ethnopharmacological knowledge about the plants available in their surroundings. Strengthening the wise use and conservation of indigenous knowledge of useful plants may benefit and improve the wellbeing of poor people (Kunwar & Bussmann, 2008). Dhimal is one among 59 ethnic groups identified by the Government of Nepal (Bhattarai & Niraula, 2020). Dhimal's settlement is mainly concentrated in Morang and Jhapa districts of Koshi Province of Nepal. The main settlement area of Dhimal is stretched east to west along the foothills around the forest belts of Chure mountain range. It is said that the Dhimal people belong to Kiratis and are believed to have settled down along the northern or north-eastern Himalayan region long before 1000 B.C. or even before (Dhimal, 1973).

Ethnobotany is a set of empirical local practices embedded in the indigenous knowledge of a social group often transmitted from generation to generation (Kunwar & Bussmann, 2008) which influence the health problems and intent to overcome such problems (Njoroge *et al*., 2004). The concept of ethnobotany considers and includes all studies, which focus on the mutual relationship between plants and traditional people (Harshberger, 1896). People still depend upon the traditional practitioners who have been using the indigenous ethnobotanical knowledge (Koirala & Khaniya, 2009). The possibility to better understand the relationships among the people, their culture and the environment has central importance because it

allows the characterization of social systems through their particular environmental perception, and provides useful tools (Toledo *et al*., 2009). The ethnobotanical plants have the potential to treat a wide range of illnesses and there is the need to validate their uses for therapeutic application with further research on the isolation and characterization of the plant active compounds for the discovery of potential drugs (Asiimwe *et al*., 2021). The indigenous knowledge is an important part of the primary health care system and are the last storehouse of traditional knowledge which is under the constant threat of losing valuable information (Khajuria *et al*., 2021)especially the far–flung areas. These areas, one of the last storehouses of traditional knowledge are under the constant threat of losing this valuable information as it moves from one generation to another through word of mouth. Modernization, migration, education, and changing socio–economic status of people also affect the perpetuality of traditional knowledge. Therefore, time-to-time updation of information regarding the ethnomedicinal plants must be carried out so that any addition to the traditional knowledge is recorded and further phytochemical and pharmacological studies may be conducted for developing new drugs. Aim of the study: The study aimed at documenting the traditional knowledge and practices about the medicinal plants used by the inhabitants of Pauri district of Uttarakhand. Besides, the study strives to identify plants for future phytochemical and pharmacological studies. Material and methods: The information was collected through semi–structured questionnaire from 98 informants distributed in 15 villages of Pauri. The data was analyzed for use–reports (UR. The loss of traditional medicinal knowledge in a culture that is undergoing a rapid change is as irreversible as the loss of plant species (Joshi & Joshi, 2000). Ethnobotanical knowledge should be consolidated with modern biotechnologies to achieve desired end products with scientific validation. The ethnobotanicals can be an alternative to problem of anti-biotic resistance (Sohail *et al*., 2012).

Phytochemical screening is the scientific process of analyzing, examining, extracting, experimenting, and identifying different classes of phytoconstituents in various parts of the base for the discovery of drugs, the active components could be further taken for investigation. The outcome of the investigation could be fruitful in developing potent drugs against various diseases (Sharma *et al*., 2020). Chemicals released from plants and imposing allelopathic influences are termed as allelochemicals and they can exist in several parts of plants including roots, rhizomes, leaves, stems, pollen, seeds and flowers. These allelochemicals could be the main reason for the restricted growth of other plant species near their colony. The allelopathic plants pose threat on seed germination, seedlings radicle and plumule lengths of wheat and barley (Tessema & Tura, 2018). Ethnomedicinal documentation, combined with phytochemical and bioactivity screening, is a convincing method for identifying new drugs from medicinal plants that play an essential role in human health (Sher & Aldosari, 2012). Also, determining the allelopathic effect of those plants helps to provide accessible, safe, reliable and inexpensive sources of control of various weeds (Gautam *et al*., 2021). Allelopathic potentials of plants which persuades identifying and purification of allelopathic substances, may result in controlling specific weeds through their use as natural herbicides (Hassan *et al.*, 2012).

Ethnobotanicals have been studied elsewhere for their chemical composition and biological activities. However, the published data are scant regarding the ethnobotany and pharmacological properties of the ethnobotanical plants. Most of the ethnomedicinal studies conducted in recent years in Nepal have only documented whether the community people have knowledge about the use of plants or not but have not mentioned about the phytochemical screening along with the allelopathic potential of these plants. Therefore, along with documentation and phytochemical screening of the ethnobotanicals, test for allelopathic potential would preserve and promote its use as an ingredient in agriculture and other industries. Efforts should be made to document the medicinal use of the plants before much of this is eliminated, or before the inhabitants of the region abandon their traditional medical practices (Joshi & Joshi, 2000).

## 2. MATERIALS AND METHODS

### *2.1 Conceptual framework*

The focus of the research was to document the ethnomedicinal plants used by Dhimal community of Urlabari municipality, their phytochemical screening and discovering their allelopathic potential. Overall conceptual framework of the research is presented as:

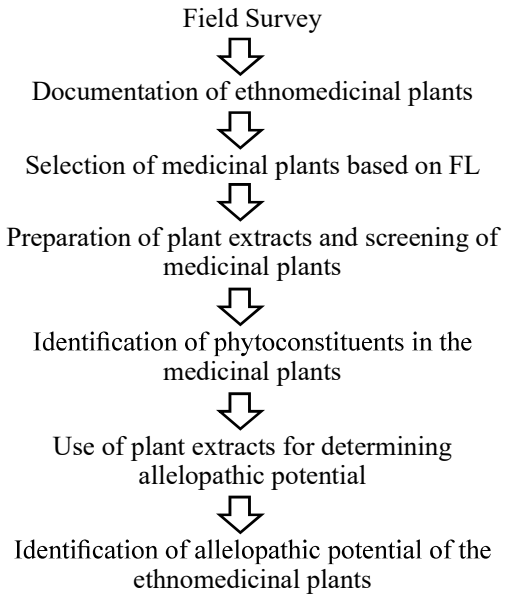


**Figure 1.** Conceptual framework for the research

### *2.2 Study area*

Urlabari municipality of Morang district was selected for the survey. The main basis of selection of this site was because of the accessibility and dominance of Dhimals (7.55%). The ethnomedicinal plants were collected from the survey site which is located at 26°39' N and 87°37' E. The laboratory activities were carried out at the Institute of Agriculture and Animal Science (IAAS), Gauradaha Agriculture Campus, Gauradaha, Jhapa located at 26°33' N and 87°43' E. Geographically, the survey and experimental location both lies in the fertile Terai plains of the Koshi Province of eastern Nepal.

### *2.3 Fidelity level (FL)*

The fidelity level (FL) was expressed as the percentage of informants claiming the use of a certain plants for the same major purpose and calculated as per Alexiades (1996):

$$FL\ \% = \frac{I_p}{I_u} \times 100$$

Where, Ip = the number of informants who independently suggested the use of a plant species for a particular disease and Iu = total number of informants who mentioned the same plant for any disease.

### *2.4 Plant extract preparation*

The medicinal plant parts were collected, cleaned with running water and dried under shade at room temperature (30 ±5$^0$C) for 10 days (Handa *et al*., 2008).

#### *2.4.1 Preparation of crude powder*

After about 10 days of shade drying, well dried plants parts were grinded and then product was subjected to mass sieving to obtain fine powder. The obtained powder was then kept in a plastic jar with airtight lid and stored for the required period (Khanal, 2021).

#### *2.4.2 Preparation of stock solution*

100 grams crude powder of each collected parts was soaked in 1000 ml of distilled water separately and left for overnight in an airtight plastic bottle for maceration. Mixture was then filtered and used further (Khanal, 2021). The prepared extract of all the ethnomedicinal plants were used for phytochemical screening.

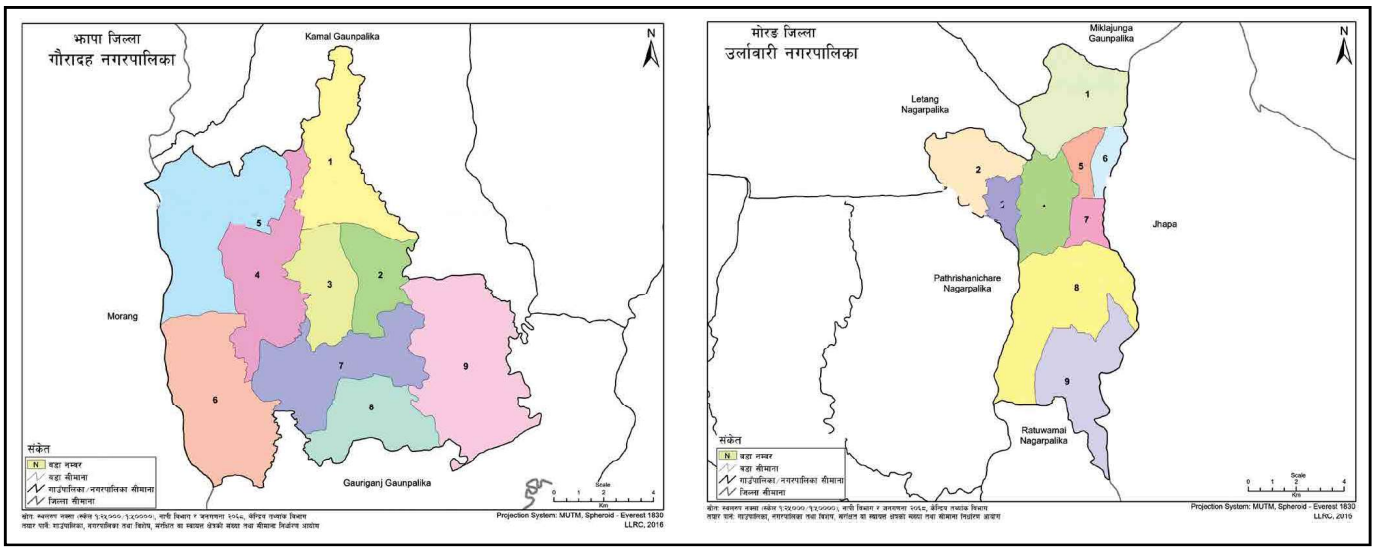


**Figure 2.** Research sites

*Source: LLRC, 2016*

### *2.5 Quantitative Phytochemical Analysis*

Quantitative test of phytochemical was done by the gravimetric method described as per Harborne (1973):

#### *2.5.1 Test for alkaloid*

Five grams of sample dust was dissolved in 100 ml of 10% acetic acid. It was well soaked and left for 4 hours. The solution was then filtered and the filtrate was evaporated to ¼$^{th}$ of its original volume. Concentrated Ammonium hydroxide ($NH_4OH$) was added drop wise to precipitate the alkaloid content. Solution was then filtered again and washed with 1% $NH_4OH$. Filter paper containing precipitate was dried in the oven at $60^0$C for 30 minutes and was weighed after being allowed to cool for a few minutes. The total alkaloid content was then calculated as per Harborne (1973):

$$\text{Alkaloid \%} \quad \frac{W_2 - W_1}{W_1} \times 100$$

Where, $W_1$ = weight of empty filter paper, $W_2$ = weight of paper + alkaloid precipitate

#### *2.5.2 Test for terpenoid*

Dried plant extract 10 grams ($W_i$) was taken and soaked in 90 ml of ethanol. The extract after filtration was mixed with 10 ml of petroleum ether and again filtered using a separating funnel. The extract was then waited for its complete drying and measurement was taken ($W_f$). The total terpenoids contents was measured as per Indumathi *et al*. (2014):

$$\text{Terpenoid \%} = \frac{W_i - W_f}{W_1} \times 100$$

Where, $W_i$ = dried plant extracts, $W_f$ = extracts after drying

#### *2.5.3 Test for saponin*

The plant extract i.e., 25 ml was placed in a round bottom flask. 100 ml of 50% alcohol was added, boiled for 30 minutes and filtered while hot through a filter paper. 2 gm of charcoal was added to the filtrate and it was boiled and filtered while hot. The filtrate was then cooled and an equal volume of acetone was added to completely precipitate the saponins. The precipitated saponins was collected and calculated as per Muhammad & Abubakar (2016):

$$\text{Saponin \%} = \frac{W_2 - W_1}{W_1} \times 100$$

Where, $W_1$ = weight of filter paper, $W_2$ = weight of residue + weight of filter paper

#### *2.5.4 Test for allelopathy*

The phytotoxic activity of different plant extracts on the selected plant was investigated by using different concentrations of the extracts. Out of 23 plants, 5 plants were selected on the basis of fidelity level and the plant extracts were then subjected to test allelopathy. Wheat seeds were used as experimental plants and it was assumed that Vijaya variety of wheat would perform better even in the laboratory. A total of twenty wheat seeds of Vijaya variety (soaked overnight) were placed in each petri-plate with moistened filter paper inside. Each seed was then placed at equal distances and moisture was provided according to the concentration of extracts. Data of germinated seeds, radicle and plumule length of wheat seedlings were recorded and the temperature and relative humidity of laboratory during the whole experiment were also noted. Altogether, 14 treatments and one control with distilled water and 3 replications were arranged in the laboratory of Gauradaha Agriculture Campus in completely randomized design (CRD). Each treatment was maintained as 5,10 and 15% of prepared stock solution (Gyawali *et al*., 2021).

**Table 1.** Treatment details for assessing allelopathic potential of important medicinal plants

| Plants | Concentration (%) | Treatment |
|---|---|---|
| Control | 0 | T0 |
| *Azadirachta indica* A. Juss | 5 | T1 |
| *Azadirachta indica* A. Juss | 10 | T2 |
| *Azadirachta indica* A. Juss | 15 | T3 |
| *Cuscuta reflexa* Roxb. | 5 | T4 |
| *Cuscuta reflexa* Roxb. | 10 | T5 |
| *Cuscuta reflexa* Roxb. | 15 | T6 |
| *Mimosa pudica* L. | 5 | T7 |
| *Mimosa pudica* L. | 10 | T8 |
| *Mimosa pudica* L. | 15 | T9 |
| *Achyranthes aspera* L. | 5 | T10 |
| *Achyranthes aspera* L. | 10 | T11 |
| *Achyranthes aspera* L. | 15 | T12 |
| *Acorus calamus* L. | 5 | T13 |
| *Acorus calamus* L. | 10 | T14 |
| *Acorus calamus* L. | 15 | T15 |

**Figure 3.** Laboratory set-up for the test of allelopathic potential

### *2.6 Data entry and analysis*

The survey was taken with the help of m-Water Surveyor while other experimental data were entered in MS Excel, followed by tabulation and arrangement. Data were subjected to square root transformation before further analysis. Statistical analysis was carried out using R-stat version (4.2.1) and mean separation by DMRT (Duncan Multiple Range Test) at 5% level of significance. Package "Agricole" was used for mean separation and "Rstatix" for calculating standard error.

## 3. RESULTS AND DISCUSSION

### *3.1 Plant characteristics*

A total of 23 medicinal plants belonging to 20 families were recorded during the survey. Majority of the plants (52%) were obtained in cultivated form. Leaves were used mostly rather than other parts because of easy collection and presence of secondary metabolites available in leaves. The life forms of the plants were presented below in figure 4.

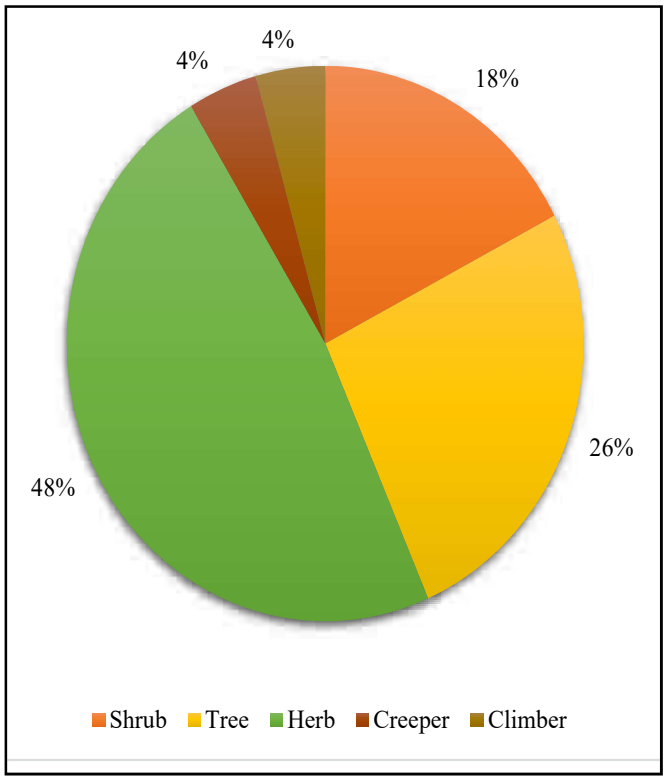


**Figure 4.** Life form of medicinal plants

### *3.2 Knowledge and concern regarding the use of medicinal plants*

Majority of the respondents (80.87%) agreed that they have been sharing the knowledge regarding ethnobotanicals to their family members. Talking about the need of documentation in scale, more than half of the respondents (57.39%) suggested the strong need of documentation of ethnomedicinal plants while the least (1.74%) gave a neutral opinion regarding documentation. Majority of the respondents (54%) didn't show any interest at all and were not ready to take concern in the use and promotion of ethnomedicinal plants. Majority (87%) supported pharmaceutical drugs more accessible and used for instant healing than ethnobotanicals, y*et al*l (100%) agreed on the economic viability of ethnobotanicals. So, ethnomedicinal plants could be assessed and explored for potential drugs (Sharma *et al*., 2020) from which economically weak households also can be benefitted for cure of ailments.

### *3.3 Fidelity level (FL)*

While selecting the most preferred plant species for each ailment category, the highest fidelity level values were considered in each category of ailment. *Cuscuta reflexa* Roxb., *Mimosa pudica* L. and *Azadirachta indica* L. were found to have maximum FL (100%) followed by *Achyranthes aspera* L. (81.33%) and *Acorus calamus* L. (65.44%). The plant species with the highest FL is considered the most preferred and important species for a particular purpose (Hoffman & Gallaher, 2007). Plants with the highest FL values were an indication of their good healing potential in their respective ailment categories.

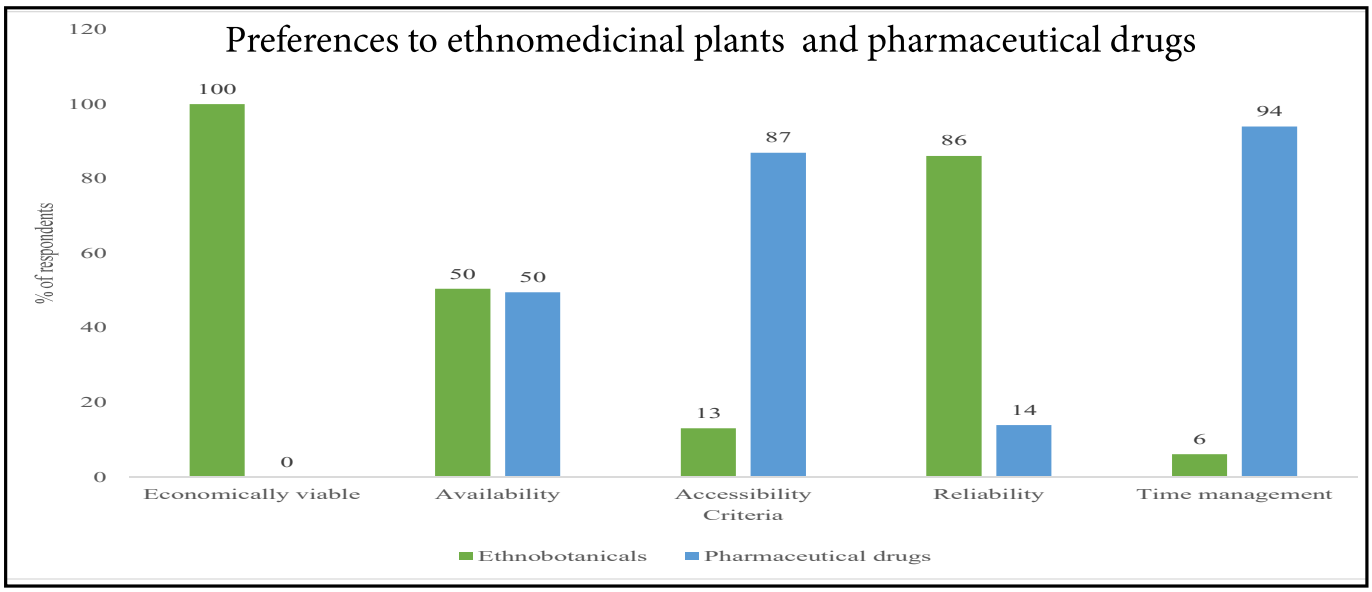


**Figure 5.** Preference to ethnomedicinal plants and pharmaceutical drugs based on different criteria

**Table 2.** Fidelity level of different medicinal plants

| Ailment categories | Medicinal plants | Np | N | FL (%) |
|---|---|---|---|---|
| Against jaundice | *Cuscuta reflexa* Roxb. | 67 | 67 | 100.00 |
| Against pneumonia | *Mimosa pudica* L. | 29 | 29 | 100.00 |
| Against skin disease | *Azadirachta indica* A. Juss | 29 | 29 | 100.00 |
| Against fever | *Achyranthes aspera* L. | 61 | 75 | 81.33 |
| Against cough, cold & sore-throat | *Acorus calamus* L. | 89 | 136 | 65.44 |
| In burn, cuts & wound | *Aloe barbadensis* Mill. | 9 | 14 | 64.29 |
| Against high blood pressure | *Artemisia vulgaris* L. | 16 | 25 | 64.00 |
| Against gastro-intestinal disorder | *Oroxylum indicum* L. | 26 | 42 | 61.90 |
| Against urinary problem | *Centella asiatica* L. | 8 | 14 | 57.14 |
| Against body pain | *Melia azedarach* L. | 2 | 4 | 50.00 |

Np=Citation for the particular ailment, N=Particular plant used, FL=Fidelity level

### *3.4 Quantitative evaluation of medicinal plants*

Quantitative analysis of phytochemicals was done as explained by Harbone (1973) by the gravimetric method. Phytochemical screening of alkaloid, terpenoid and saponin was done in the selected medicinal plants (*A. indica* A. Juss, *C. reflexa* Roxb, *M. pudica* L., *A. aspera* L. and *A. calamus* L.) and the result was tabulated. It was observed that *Mimosa pudica L.* had the highest alkaloid (15.39%), *Cuscuta reflexa* Roxb. had the highest terpenoid (9.17%) and *Acorus calamus L*. had the highest saponin (5.49%) when calculated. The contents of alkaloid and saponin obtained from the leaves of *A. indica* A. Juss were in agreement with Khanal (2021). Variation in result among the tested medicinal plants may be due to the plant parts used, geographical factor, solvent used, procedure followed and other external factors. Limited research has been done for the quantitative analysis of phytoconstituents for only a few medicinal plants while some plants have not been mentioned till date for phytochemical analysis.

**Table 3.** Phytoconstituent composition in important medicinal plants

| Medicinal plants | Alkaloid (%) | Terpenoid (%) | Saponin (%) |
|---|---|---|---|
| *Azadirachta indica* A. Juss | 11.05 | 5.00 | 2.32 |
| *Cuscuta reflexa* Roxb. | 5.67 | 9.17 | 1.92 |
| *Achyranthes aspera* L. | 7.97 | 3.00 | 1.58 |
| *Mimosa pudica* L. | 15.39 | 0.83 | 2,05 |
| *Acorus calamus* L. | 12.66 | 3.17 | 5.49 |

### *3.5 Allelopathic potential of medicinal plants*

Germination of wheat seedlings was found to be maximum in control ($3.24^{ab}$±0.09) while heavily controlled germination was observed in 15% stock solution of *A. calamus* L. ($1.05^{f}$ ±0.17) as shown in appendix 2. Germination of seedlings were found to be constant after 6 days of placement of seeds. It was observed that with increase in concentration of plant extracts, resulted in reduction of germination i.e., inhibitory activity was dependent on the extract concentrations and the higher extract concentration resulted in the stronger inhibitory activity (Salam & Kato-Noguchi, 2010;Salam, 2018).

Radicle and plumule growth found under control treatment were $2.94^{a}$ ± 0.09cm and $2.70^{a}$ ± 0.17cm respectively which was maximum. The 15% of stock solution of *Acorus calamus* L. extract resulted in a highly significant ($p < 0.01$) and maximum reduction in radicle length ($1.14^{e}$ ± 0.22cm) and plumule length ($1.04^{h}$ ± 0.17cm). It was observed that the effectiveness of plant extracts was greater on root growth to that of the shoot growth of the plants used for allelopathy test which was supported by (Asgharipour & Armin, 2010). Similar finding was observed in mungbean which concluded that the allelopathic effect was important in controlling the seedling growth and only the control treatment bored germination with proper radicle and plumule development *(*Gyawali *et al*., 2021).

## 4. CONCLUSION

The majority of plants under investigation were contributing majorly herbs followed by tree, shrub and creeper and climbers belonging to 20 families. The most frequently medicinally utilized plant parts were leaves and bark followed by root and rhizome. Mimosa pudica L. had the highest alkaloid and lower terpenoid, Cuscuta reflexa Roxb. had the highest terpenoids and the lowest alkaloids, Acorus calamus L. had the highest saponin and Achyranthes aspera L. had the lowest saponin. This indicates that different medicinal plants are known to produce secondary metabolites which influence the growth of other plants. Acorus calamus L. was discovered with the highest allelopathic potential on wheat seedling growth which might be fruitful for weed management in other crops as well which needs further investigation. Various studies have given clear ideas regarding the phytoconstituents along with their inhibitory effects against either ailments or weed management. Thus, along with the documentation of important medicinal plants which have been used from early days, proper studies and researches regarding their different properties can be carried out. Research activities related to ethnobotanicals can be fruitful in exploring and discovering new drugs. These ethnomedicinal plants have some allelopathic potential and can be an alternative for weed management in agriculture. Considering their availability, effectiveness and reliability, use of these ethnomedicinal plants should be encouraged rather than being limited within the indigenous community.

## ACKNOWLEDGEMENTS:

The authors are thankful to Gauradaha Agriculture Campus, Institute of Agriculture and Animal Science (IAAS), Tribhuvan University (TU) for the support. Authors are also highly indebted to technical staffs and friends for their valuable assistance in laboratory works.

## REFERENCES


Acharya, R. & Acharya, K. P. (2009). Ethnobotanical study of medicinal plants used by Tharu Community of Parroha VDC, Rupandehi District, Nepal. *Scientific World, 7*(7): 80–84. https://doi.org/10.3126/SW.V7I7.3832.

Alexiades, M. (1996). Collecting ethnobotanical data: An introduction to basic concepts and techniques. *In Selected Guidelines for Ethnobotanical Research: A Field Manual*, pp. 53–94.

Asgharipour, M. R. & Armin, M. ( 2010). Inhibitory effects of *Sorghum halepens* root and leaf extracts on germination and early seedling growth of widely used medicinal plants. *Advances in Environmental Biology*, 316–325.

Asiimwe, S. Namukobe, J. Byamukama, R. & Imalingat, B. (2021). Ethnobotanical survey of medicinal plant species used by communities around Mabira and Mpanga Central Forest Reserves, Uganda. *Tropical Medicine and Health, 49*(1). https://doi.org/10.1186/S41182-021-00341-Z.

Bhattarai, N. & Niraula, K. (2020). A complete description of Urlabari Municipality. *Urlabari Bulletin, 2*, 5–33.

Dhimal, S. (1973). *Brief Introduction of the Dhimal*.

Gautam, S. Khanal, S. Mishra, S. & Khanal, D. (2021). Screening of phytochemicals and allelopathic potential of selected botanicals on germination and growth of maize (*Zea mays* l.) at Paklihawa, Nepal, *1*: 138–146.

Gyawali, I. Bhattarai, S. & Khanal, S. (2021). Ethnobotanical, phytochemical, and allelopathic potential of traditional medicinal plants. *Turkish Journal of Agriculture - Food Science and Technology, 9*: 224–233. https://doi.org/10.24925/turjaf.v9i1.224-233.3873.

Handa, S. S. Khanuja, S. P. S. Longo, G. & Rakesh, D. D. (2008). Extraction technologies for medicinal and aromatic plants. *International Centre For Science And High Technology*, 32.

Harborne, J. B. (1973). Phenolic compounds. *Phytochemical methods*, 33–88. https://doi.org/10.1007/978-94-009-5921-7_2.

Harshberger, J. W. (1896). The purposes of ethno-botany. *Botanical Gazette, 21*(3): 146–154. https://doi.org/10.1086/327316.

Hassan, M. M. Daffalla, H. M. Yagoub, S. O. Osman, M. G. Gani, M. E. A. & Babiker, A. G. E. (2012). Allelopathic effects of some botanical extracts on germination and seedling growth of *Sorghum bicolor* L. *Journal of Agricultural Technology, 8*(4): 1423–1469.

Hoffman, B. & Gallaher, T. (2007). Importance indices in ethnobotany. *Ethnobotany Research and Applications*, 5: 201–218.

Indumathi, C. Durgadevi, G. Nithyavani, S. and Gayathri, P. (2014). Estimation of terpenoid content and its antimicrobial property in *Enicostemma litorrale*. *International Journal of ChemTech Research, 6*: 4264–4267.

Joshi, A. R. & Joshi, K. (2000). Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal. *Journal of Ethnopharmacology, 73*(1–2): 175–183. https://doi.org/10.1016/s0378-8741(00)00301-9.

Khajuria, A. K. Manhas, R. K. Kumar, H. & Bisht, N. S. (2021). Ethnobotanical study of traditionally used medicinal plants of Pauri district of Uttarakhand, India. *Journal of Ethnopharmacology*, 276. https://doi.org/10.1016/J.JEP.2021.114204.

Khanal, S. (2021). Qualitative and quantitative phytochemical screening of *Azadirachta indica* Juss. plant parts. *International Journal of Applied Sciences and Biotechnology, 9*(2): 122–127. https://doi.org/10.3126/IJASBT.V9I2.38050.

Koirala, R. R. & Khaniya, B. N. (2009). *Present status of traditional medicines and medicinal & aromatic plants related resources & organizations in Nepal*. Nepal Health Research Council.

Kunwar, R. M. & Bussmann, R. W. (2008). Ethnobotany in the Nepal Himalaya. J*ournal of Ethnobiology and Ethnomedicine, 4*(1): 24. https://doi.org/10.1186/1746-4269-4-24.

Muhammad, S. A. & Abubakar, S. M. (2016). Qualitative and quantitative determination of phytochemicals in aqueous extract of *Chrysophyllum albidum* seed kernel. *Biosciences Biotechnology Research Asia, 13*(2): 1201–1206. https://doi.org/10.13005/BBRA/2153.

Njoroge, N. G. Bussmann, R. W. Gemmill, B. Newton, L. E. & Ngumi, V. M. (2004). Utilisation of weed species as

sources of traditional medicines in central Kenya. *Lyonia, 7*(2): 71-87.

Salam, M. A. (2018). Evaluation of allelopathic potential of neem (*Azadirachta indica*. A. Juss) against seed germination and seedling growth of different test plant species. *American-Eurasian Journal of Sustainable Agriculture*, *2*.

Salam, M. A. & Kato-Noguchi, H. (2010). Evaluation of allelopathic potential of neem (*Azadirachta indica.* A. Juss) against seed germination and seedling growth of different test plant species. *International Journal of Sustainable Agriculture, 2*(2): 20–25.

Sharma, T. Pandey, B. Shrestha, B. K. Koju, G. M. Thusa, R. & Karki, N. (2020). Phytochemical screening of medicinal plants and study of the effect of phytoconstituents in seed germination. Tribhuvan University Journal, 35(2): 1–11. https://doi.org/10.3126/TUJ.V35I2.36183.

Sher, H. & Aldosari, A. (2012). Overview on the ecological and geographical appraisal of important medicinal and aromatic plants: An endangered component in the flora of Saudi Arabia. *Scientific Research and Essays, 7*: 1639–1646. https://doi.org/10.5897/SRE12.183.

Sohail, A., Hamid, F. S., Waheed, A., Ahmed, N., Aslam, N., Zaman, Q., Ahmed, F., & Islam, S. (2012). Efficacy of different botanical Materials against aphid *Toxoptera aurantii* on tea (*Camellia sinensis* L.) cuttings under high shade nursery. *Journal of Materials and Environmental Sciences, 3*(6): 1065–1070.

Tessema, S. S. and Tura, A. M. (2018). Allelopathic property of Parthenin on seed germination and seedling growth of wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*). International Journal of Chemical and Biochemicl Sciences, 14: 23–27.

Toledo, B. A. Galetto, L. & Colantonio, S. (2009). Ethnobotanical knowledge in rural communities of Cordoba (Argentina): The importance of cultural and biogeographical factors. *Journal of Ethnobiology and Ethnomedicine, 5*: 40. https://doi.org/10.1186/1746-4269-5-40.

## ANNEX

**Appendix 1.** List of documented plants along with their other information

| S.N | Local name | Common name | Scientific name | Family | Type of plant | Life form of plant | Parts used | Method of Use and Administration | Ethno-medicinal uses |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Aank | Ank | *Calotropis gigantea* L. | Apocynaceae | Wild | Shrub | Root | Root juice is extracted. | In burn, cuts & wound |
| 2 | Amala | Amla | *Phyllanthus emblica* L. | Euphorbiaceae | Cultivated | Tree | Fruit | Fruits are consumed directly. | Against gastro-intestinal disorder & jaundice |
| 3 | Ambak | Guava | *Psidium guajava* L. | Myrtaceae | Cultivated | Tree | Bark | Bark extract is obtained by crushing the bark. | Against gastro-intestinal disorder |
| 4 | Bakaino | Bakaino | *Melia azedarach* L. | Meliaceae | Wild | Tree | Leaves | Leaf juice is extracted. | Against urinary problem & body pain |
| 5 | Barro | Barro | *Terminalia bellirica* Gaertn. Roxb. | Combretaceae | Cultivated | Herb | Fruit | Fruits are consumed directly. | Against cough, cold & sore-throat |
| 6 | Bayer | Indian plum | *Ziziphus mauritiana* Lam. | Rhamnaceae | Wild | Tree | Root | Juice is extracted by crushing the roots. | Against fever |
| 7 | Besar | Turmeric | *Curcuma longa* L. | Zingiberaceae | Cultivated | Shrub | Rhizome | Powder is extracted from dried rhizome. | Against cough, cold & sore-throat & gastro-intestinal disorder |
| 8 | Bhringraj jhar | False daisy | *Eclipta prostrata* L. | Asteraceae | Wild | Herb | Whole plant | Plant is crushed and juice is extracted. | In cuts & wound |
| 9 | Bojho | Sweet flag | *Acorus calamus* L. | Acoraceae | Cultivated | Herb | Rhizome | Small piece of dried rhizome is chewed or tied on the neck | Against cough, cold & sore-throat |
| 10 | Gheukumari | Aloe vera | *Aloe barbadensis* Mill. | Liliaceae | Cultivated | Herb | Leaves | Jel is extracted , used or consumed. | Against fever & in burn, cuts & wound |
| 11 | Godhtapre | Godhtapre | *Centella asiatica* L. | Apiaceae | Wild | Herb | Leaves | Leaf juice is extracted. | Against gastro-intestinal disorder & urinary problem |
| 12 | Gurjo | Gurjo | *Tinospora cordifolia* L. | Menispermaceae | Cultivated | Climber | Stem, leaves | Decoction of fresh leaves and stem. | Against fever |

| S.N | Local name | Common name | Scientific name | Family | Type of plant | Life form of plant | Parts used | Method of Use and Administration | Ethno-medicinal uses |
|---|---|---|---|---|---|---|---|---|---|
| 13 | Lajjawati jhar | Lajjawati jhar | *Mimosa pudica* L. | Fabaceae | Wild | Creeper | Root | Roots are crushed and taken orally. | Against pneumonia |
| 14 | Neem | Neem | *Azadirachta indica* A. Juss | Meliaceae | Wild | Tree | Leaves | Leaf extract is obtained and used for bathing | Against skin disease |
| 15 | Pahelo lahara | Cuscuta | *Cuscuta reflexa* Roxb. | Convolvulaceae | Wild | Herb | Stem | Juice is made, filtered and consumed or use for bathing | Against jaundice |
| 16 | Parijat | Parijat | *Nyctanthes arbor-tristis* L. | Oleaceae | Cultivated | Shrub | Leaves, flower | Leaves and flowers are crushed and consumed. | Against fever, cough, cold & sore-throat |
| 17 | Patharchatta | Bryophyllum | *Kalanchoe pinnata* L. | Crassulaceae | Herb | | Leaves | Fresh leaves are chewed. Leaf juice is also extracted. | Against gastro-intestinal disorder |
| 18 | Pudina | Pudina | *Mentha spicata* L. | Lamiaceae | Cultivated | Herb | Leaves | Juice is extracted from leaves. Fresh leaves consumed directly. | Against gastro-intestinal disorder & fever |
| 19 | Sadabahar | Periwinkle | *Catharanthus roseus* L. | Apocynaceae | Cultivated | Herb | Leaves, flower | Leaves and flowers are consumed directly. | Against high blood pressure |
| 20 | Titepati | Common mugwort | *Artemisia vulgaris* L. | Asteraceae | Wild | Herb | Leaves | Decoction of fresh leaves. Leaf juice is also extracted. | Against high blood pressure & skin disease |
| 21 | Totelo | Tatelo | *Oroxylum indicum* L. | Bignoniaceae | Wild | Tree | Leaves, bark | Decoction of fresh leaves. Bark extract is also obtained. | Against gastro-intestinal disorder & jaundice |
| 22 | Tulsi | Tulsi | *Ocimum tenuiflorum* L. | Lamiaceae | Cultivated | Shrub | Whole plant | Juice is obtained from the leaves or consumed directly. Decoction of fresh leaves. | Against fever, cough, cold & sore-throat |
| 23 | Ulto jara | Apamarg | *Achyranthes aspera* L. | Amaranthaceae | Wild | Herb | Root | Juice is extracted by crushing the roots. | Against fever cough, cold & sore-throat |

**Appendix 2.** Effect of plants extract on germination of wheat seedlings

| Treatment | Germinated seeds | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 DAP | 3 DAP | 4 DAP | 5 DAP | 6 DAP | 7 DAP | 8 DAP |
| T0 | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ | $3.24^{ab} \pm 0.09$ |
| T1 | $2.76^{abc} \pm 0.32$ | $2.99^{abc} \pm 0.33$ | $3.06^{abc} \pm 0.26$ | $3.06^{abc} \pm 0.26$ | $3.06^{abc} \pm 0.26$ | $3.06^{abc} \pm 0.26$ | $3.06^{abc} \pm 0.26$ |
| T2 | $2.00^{bcd} \pm 0.65$ | $2.12^{bcde} \pm 0.71$ | $2.23^{abcde} \pm 0.77$ | $2.23^{abcdef} \pm 0.77$ | $2.23^{abcdef} \pm 0.77$ | $2.23^{abcdef} \pm 0.77$ | $2.23^{abcdef} \pm 0.77$ |
| T3 | $1.77^{cde} \pm 0.59$ | $1.93^{cde} \pm 0.62$ | $2.06^{bcde} \pm 0.68$ | $2.06^{bcdef} \pm 0.68$ | $2.06^{bcdef} \pm 0.68$ | $2.06^{bcdef} \pm 0.68$ | $2.06^{bcdef} \pm 0.68$ |
| T4 | $2.09^{abcd} \pm 0.26$ | $2.40^{abcd} \pm 0.44$ | $2.55^{abcd} \pm 0.40$ | $2.60^{abcde} \pm 0.44$ | $2.60^{abcde} \pm 0.44$ | $2.60^{abcde} \pm 0.44$ | $2.60^{abcde} \pm 0.44$ |
| T5 | $2.34^{abcd} \pm 0.12$ | $2.73^{abcd} \pm 0.11$ | $2.73^{abcd} \pm 0.11$ | $2.73^{abcde} \pm 0.11$ | $2.73^{abcde} \pm 0.11$ | $2.79^{abcde} \pm 0.12$ | $2.79^{abcde} \pm 0.12$ |
| T6 | $0.71^{e} \pm 0.00$ | $1.56^{de} \pm 0.19$ | $1.56^{de} \pm 0.19$ | $1.64^{ef} \pm 0.26$ | $1.64^{ef} \pm 0.26$ | $1.64^{ef} \pm 0.26$ | $1.64^{ef} \pm 0.26$ |
| T7 | $3.38^{a} \pm 0.15$ | $3.44^{a} \pm 0.10$ | $3.48^{a} \pm 0.13$ | $3.48^{a} \pm 0.13$ | $3.48^{a} \pm 0.13$ | $3.48^{a} \pm 0.13$ | $3.48^{a} \pm 0.13$ |
| T8 | $2.40^{abcd} \pm 0.18$ | $2.67^{abcd} \pm 0.17$ | $2.74^{abcd} \pm 0.11$ | $2.86^{abcde} \pm 0.06$ | $2.86^{abcde} \pm 0.06$ | $2.86^{abcde} \pm 0.06$ | $2.86^{abcde} \pm 0.06$ |
| T9 | $2.41^{abcd} \pm 0.59$ | $2.96^{abc} \pm 0.15$ | $3.02^{abc} \pm 0.20$ | $3.02^{abcd} \pm 0.20$ | $3.02^{abcd} \pm 0.20$ | $3.02^{abcd} \pm 0.20$ | $3.02^{abcd} \pm 0.20$ |
| T10 | $2.28^{abcd} \pm 0.81$ | $2.56^{abcd} \pm 0.69$ | $2.68^{abcd} \pm 0.58$ | $2.68^{abcde} \pm 0.58$ | $2.68^{abcde} \pm 0.58$ | $2.68^{abcde} \pm 0.58$ | $2.68^{abcde} \pm 0.58$ |
| T11 | $2.74^{abc} \pm 0.00$ | $2.80^{abcd} \pm 0.06$ | $2.80^{abcd} \pm 0.06$ | $2.80^{abcde} \pm 0.06$ | $2.80^{abcde} \pm 0.06$ | $2.80^{abcde} \pm 0.06$ | $2.80^{abcde} \pm 0.06$ |
| T12 | $2.64^{abc} \pm 0.30$ | $2.91^{abc} \pm 0.17$ | $2.91^{abc} \pm 0.17$ | $2.91^{abcde} \pm 0.17$ | $2.91^{abcde} \pm 0.17$ | $2.91^{abcde} \pm 0.17$ | $2.91^{abcde} \pm 0.17$ |
| T13 | $1.72^{cde} \pm 0.51$ | $1.79^{cde} \pm 0.56$ | $1.86^{cde} \pm 0.60$ | $1.86^{cdef} \pm 0.60$ | $1.86^{cdef} \pm 0.60$ | $1.86^{cdef} \pm 0.60$ | $1.86^{cdef} \pm 0.60$ |
| T14 | $1.10^{de} \pm 0.39$ | $1.10^{e} \pm 0.39$ | $1.66^{de} \pm 0.22$ | $1.74^{def} \pm 0.27$ | $1.74^{def} \pm 0.27$ | $1.74^{def} \pm 0.27$ | $1.74^{def} \pm 0.27$ |
| T15 | $0.71^{e} \pm 0.00$ | $1.05^{e} \pm 0.17$ | $1.05^{e} \pm 0.17$ | $1.05^{f} \pm 0.17$ | $1.05^{f} \pm 0.17$ | $1.05^{f} \pm 0.17$ | $1.05^{f} \pm 0.17$ |
| Grand mean | 2.14 | 2.39 | 2.48 | 2.50 | 2.50 | 2.50 | 2.50 |
| CV | 32.08 | 27.48 | 25.92 | 26.21 | 26.21 | 26.19 | 26.19 |
| MS error | 0.47 | 0.43 | 0.41 | 0.43 | 0.43 | 0.43 | 0.43 |
| LSD | 1.14 | 1.09 | 1.07 | 1.09 | 1.09 | 1.09 | 1.09 |
| F-value | 4.01*** | 3.69*** | 3.33** | 3.11** | 3.11** | 3.12** | 3.12** |

*Mean followed by the same letter in a column are not significantly different by DMRT at 5% confidence level. DAP=Days after placement; CV=Coefficient of variation; MS error= Mean standard error; LSD=Least significant differences; ** significant 1% and ***significant 0.1% level of significance*

**Appendix 3.** Effect of plants extract on radicle and plumule length of wheat seedlings

| Treatment | Plumule length | | Radicle length | |
|---|---|---|---|---|
| | 4 DAP | 7 DAP | 4 DAP | 7 DAP |
| T0 | 2.32$^{a}$ ±0.11 | 2.70$^{a}$ ±0.17 | 2.55$^{a}$ ±0.15 | 2.94$^{a}$ ±0.09 |
| T1 | 1.46$^{d}$ ±0.10 | 1.61$^{defg}$ ±0.11 | 1.65$^{cde}$ ±0.09 | 1.84$^{cd}$ ±0.01 |
| T2 | 1.04$^{ef}$ ±0.17 | 1.12$^{gh}$ ±0.21 | 1.20$^{ef}$ ±0.25 | 1.24$^{e}$ ±0.27 |
| T3 | 1.03$^{ef}$ ±0.16 | 1.09$^{h}$ ±0.19 | 1.18$^{ef}$ ±0.24 | 1.24$^{e}$ ±0.27 |
| T4 | 1.30$^{de}$ ±0.05 | 1.40$^{efgh}$ ±0.07 | 1.52$^{de}$ ±0.03 | 1.65$^{de}$ ± 0.03 |
| T5 | 1.26$^{de}$ ±0.06 | 1.35$^{efgh}$ ±0.08 | 1.42$^{def}$ ±0.05 | 1.60$^{de}$ ±0.04 |
| T6 | 0.93$^{ef}$ ± 0.04 | 1.14$^{gh}$ ±0.08 | 1.15$^{ef}$ ±0.02 | 1.35$^{de}$ ±0.02 |
| T7 | 2.04$^{ab}$ ±0.03 | 2.16$^{bc}$ ±0.03 | 2.18$^{ab}$ ±0.07 | 2.35$^{bc}$ ±0.02 |
| T8 | 1.91$^{bc}$ ±0.04 | 2.09$^{bcd}$ ±0.06 | 2.12$^{abc}$ ±0.04 | 2.28$^{bc}$ ±0.01 |
| T9 | 1.53$^{cd}$ ±0.01 | 1.76$^{cde}$ ±0.10 | 1.73$^{bcd}$ ±0.07 | 1.88$^{cd}$ ±0.08 |
| T10 | 2.24$^{ab}$ ±0.03 | 2.35$^{ab}$ ±0.03 | 2.37$^{a}$ ±0.03 | 2.46$^{b}$ ±0.04 |
| T11 | 1.87$^{bc}$ ±0.13 | 2.06$^{bcd}$ ± 0.13 | 2.17$^{ab}$ ± 0.11 | 2.30$^{bc}$ ±0.11 |
| T12 | 1.62$^{cd}$ ±0.35 | 1.70$^{cdef}$ ±0.35 | 1.81$^{bcd}$ ±0.33 | 1.84$^{cd}$ ±0.34 |
| T13 | 1.01$^{ef}$ ±0.15 | 1.20$^{fgh}$ ±0.25 | 1.20$^{ef}$ ±0.25 | 1.36$^{de}$ ± 0.33 |
| T14 | 1.01$^{ef}$ ±0.13 | 1.31$^{efgh}$ ±0.07 | 1.19$^{ef}$ ±0.16 | 1.47$^{de}$ ±0.03 |
| T15 | 0.81$^{f}$ ±0.06 | 1.04$^{h}$ ±0.17 | 0.92$^{f}$ ±0.11 | 1.14$^{e}$ ±0.22 |
| Grand mean | 1.46 | 1.63 | 1.65 | 1.81 |
| CV | 15.36 | 16.55 | 16.31 | 15.93 |
| MS error | 0.05 | 0.07 | 0.07 | 0.08 |
| LSD | 0.37 | 0.45 | 0.45 | 0.48 |
| F-value | 14.37*** | 10.72*** | 10.62*** | 10*** |

Mean followed by the same letter in a column are not significantly different by DMRT at 5% confidence level.

DAP=Days after placement;

CV=Coefficient of variation;

MS error=Mean standard error;

LSD=Least significant differences;

** significant 1% and ***significant 0.1% level of significance.