Identifying Constraints Perceived by Farmers Practicing Groundnut Cultivation in Odisha, India

ABSTRACT

Background: The groundnut cultivation also presents challenges such as climate change, appropriate seed selection, and land preparation techniques, which have a significant impact on groundnut production and need the adoption of new technology.
Aims: The present studyidentifiestheconstraintsfacedbytherespondentsingroundnutcultivation in Balasore district of Odisha, India.
Study design:*Ex post facto* research design
Place and Duration of Study: The study was carried out from the first week to the fourth week of May 2023.
Methodology: The random sampling approach was used to pick one hundred twenty (120) respondents from three blocks in Odisha's Balasore district. A structured interview schedule was prepared to collect the data. Personal interview was conducted to collect the primary data. Data analyses was done to find out the mean score values of each statements using Microsoft Excel Software and then ranking of statements was done.
Results: The results revealed that insufficient training for Knowledge and skill enrichment availabilityofchoiceablevariety, not giving timely guidance and expertise and lack of transparency in marketing system were some of the the major constraints faced by the respondents.
Conclusion: For improving the production & productivity of groundnut, a need-based action plan for the betterment of farmers in particularly groundnut growers in the state has to be formulated and the constraints such as timely allocation of resources, proper credit facilities and awareness about management practices among others has to dealt with.

Keywords: groundnut, climate change, irrigation, productivity

1. INTRODUCTION

Groundnut is a popular leguminous crop that plays an important part in the global agricultural landscape. India and China together account for nearly two-thirds of world output. Other major producers include Nigeria, Senegal, Sudan, and Argentina. Kernels are commonly used in underdeveloped nations for oil extraction, food production, and confectionary items [1].However, groundnut production and marketing confront various problems, particularly in places such as Ethiopia, Burkina Faso, and India [2,3,4]. India accounted for around 13% (5.8 million ha.) of the world's oilseeds area, 5.2 percent (25.2 million tons) of the world's oilseed production, and 18% of the world's edible oil consumption [5]. During the rabi season in the eastern state of India, Odisha, groundnut cover 123 thousand hectares, respectively. The crops' production was low due to insufficient irrigation water and poor irrigation management [6]. The groundnut cultivation also presents challenges such as climate change, appropriate seed selection, and land preparation techniques, which have a significant impact on groundnut production and need the adoption of new technology [7,8,12]. Thus, there is a need to improve the production and productivity of the oilseeds through the adoption of suitable technologies and assist the farmers in attaining sustainable livelihood. With this background, the study aimed to identify different constraints perceived by farmers in groundnut cultivation in Balasore district of eastern state of Odisha, India.

2. MATERIAL AND METHODS

2.1 Research Design

An *ex post facto* research design was used for the research.

2.2 Sampling Design

In order to carry out the study, the district of Balasore was identified as a significant area where groundnut cultivation has flourished over extensive acres for the last five decades. Given that the participants are groundnut cultivators, it was decided to incorporate three prominent groundnut-producing blocks, namely Basta, Baliapal, and Jaleswar. The structured interview schedule was administered directly to the selected groundnut cultivators to gather the requisite data for the study. A roster of groundnut cultivators from the designated blocks was obtained from block extension personnel. From each block, four Gram Panchayats were randomly chosen. As a result, a total of 120 groundnut growers were randomly selected for the research.

2.3 Selection of Constraints

The constraints addressed in the study pertain to the research issue and the challenges encountered by respondents in the effective cultivation of groundnut. These constraints were categorized into planning, technological support, service & supply, monitoring & supervision, credit & finance, harvesting & post-harvesting and marketing with responses rated on a scale of agreement and questions were formulated accordingly (Table 1). The respondents' feedback was classified into categories of strongly agree, agree, and disagree, assigned scores of 3, 2, and 1, respectively.

2.4 Method of Data Collection

The researcher conducted personal interviews with the respondents using a structured interview schedule. These interviews primarily took place at the respondents' residences in a largely informal setting. The interviews were carried out from the first week to the fourth week of May 2023. The objectives of the study were conveyed to the respondents before gathering their responses. The interview schedule was articulated to the participants in their native language to ensure comprehension and facilitate accurate responses.

2.5 Data Analysis

The data collected was subsequently organized for empirical evaluation and analysis. The sum of the responses given by the respondents were subsequently used for calculating the mean score as well as ranking of the constraints using Microsoft Excel software.

Table1.Listofconstraintsselectedforthestudy

Sl No.	Constraints	Statements
1	**Planning**	Notorganizingthegrowers Nothrustforclusterapproach Nositeselectionwithcommon agreement Noparticipatorydecisionmaking Nomotivationforteamwork Notassigningtheresponsibility Insufficientattemptfortimelyofactivities
2	**Technological Support**	Insufficienttrainingforknowledge&skillenrichment Noexposurevisittogainexperience&confidence Notdistributingreferencematerials Insufficientguidance&expertise Lackofcompetencyofthefieldstaffs Extensionofficialsnotcooperative Inadequatedemonstration&field days Noclarificationofdoubts Noregularmonitoring&supervision Anyother(specify)
3	**Service&supply**	Notensuringavailabilityofchoice ablevariety Notliasoningforthesupplyofqualityseeds Notliasoningwithdealersfortimely supplyofrequired inputs Notensuringauthenticityofavailableplantprotection chemicals Insufficientknowledge&skillsinuseof10 feasibleimplements Customhiringservicenotavailable inthelocality Insufficient attempt in pre-arrangementofinputs&materials Anyother(specify)
4	**Monitoring&supervision**	Noregulardiagnosticvisitsconducted Timelyguidance&expertisenotgiven Noclosemonitoring&supervision Notinvolvingrelateddepartmentsfor resourcemobilisation Notliasoningfortimelyinputavailability Nointerestfortimelyoperationofallpractices Noimmediateactiononfieldproblems Notinvolvinginconflictresolution Anyother(specify)
5	**Credit & Finance**	Notliasoningwithcreditinstitutions tosanction loan Requiredamountnotsanctioned Harassmentinprocessingofdocuments Notfixinginstallmentsasperpaying capability Noconsiderationinguarantee Nosubsidyfacility Noinsurancecoverage
6	**Harvesting & post-harvesting**	Noguidancefortimelyharvest Skilldeficienciesinuseof Implements Poorknowledgeonquality maintenance Poorsoilmoisturecreation

		Noadequatespaceforproperdrying Nocommunitydryingyardfacilities Poorknowledgeonproperstoring Noinsurancecoverageforstorage loss Anyother (specify)
7	**Marketing**	Noideaaboutmarketinginformation Notguidingtocollect market information Noreasonableminimumsupportprice Notliasoningforimmediatedisposalof theproduce Nocooperativesysteminprocurement Exploitationbythetradersand businessman Notransparencyingrading &measurement Noimmediatepayment Anyother (specify)

3. RESULTS AND DISCUSSION

Following data analysis, the following results were obtained.

3.1 Constraints faced by the Groundnut growers in the planning stage:

Properplanningensurestimelyimplementationofallactivities.Properplanning also made easier in implementation of all production activities. The extensionofficials working in the study area have to plan appropriately with the groundnut growers.Themeanscorevalueindicatedthatinsufficientattemptfortimelyoperationofactivities,notorganisingthegrowers,noparticipatorydecisionmakingandno motivation for teamwork were the major constraints stated by the respondents inplanning (Table 2). The majority of respondents had also disagreed for no siteselection with common agreement, not assigning the responsibility and to some extent nothrustfor cluster approach implying thatthe extension functionariesaretaking care oftheseactivities.

Organisingthegroundnutgrowersfacilitatesproperplanning,needbasedmanagement,timelyoperationandbettersupervision.Teamworkhelpsinarranginginputs, resource mobilisation and co-operating with each other in use of recommended practices.Participatory decisionmaking ensures timely managementof productionactivities. Allthese aspects are essential for proper planning to achieve the end results. Theextensionofficials have to take necessary steps to overcome all these constraints ensuring betterplanningin managementofall productionactivities in groundnutcultivation.

Table2.Constraints faced by the Groundnut growers in the planning stage

(n=120)

Sl.no	Constraint	Strongly agree	Agree	Disagree	Mean	Rank
i)	Not organizing the growers	67	52	1	2.55	II
ii)	No thrust for cluster approach	8	49	63	1.54	V
iii)	No site selection with common Agreement	0	31	89	1.26	VII
iv)	No participatory decision making	63	46	11	2.43	III
v)	No motivation for team work	53	52	15	2.32	IV
vi)	Not assigning the responsibility	0	42	78	1.35	VI
vii)	Insufficient attempt for timely operation of activities	71	49	0	2.59	I

(Maximumobtainablescore-3)

3.2 Constraints faced by the Groundnut growers regarding technological support:

Knowledgeandskillenrichmentenablethefarmertouserecommendedpractices. Exposurevisits to ideal places develops confidence of the farmers and motivates themfor adoption. The farmers also need regular guidance and expertise for timely managementof all activities. Immediatesolving of the field problems facilitates overcoming theinconveniences. Therefore, the respondents should be provided with allthese possibletechnologicalsupport bytheextension officials. Asobservedfromtable 3,therespondentagreedaboutdistributingreferencematerialandexpertisewhichindicatesthatthese facilities are extended tothem.Similarly,therespondentshadgoodopinionsaboutthecompetency and cooperative attitude of the extension officials. In other hand, majority ofthe respondents had stated the constraints of insufficient training for knowledge and skillenrichment, no exposure visitsto gain experience and confidence along with inadequatedemonstration and field days. These activities accelerate the technological competency forrespondentsineffectivemanagementofvariouspracticesingroundnutcultivation.Hence, all these activities should be undertaken regularly enabling the respondence toacquire knowledge and skill competency and use recommended practices in groundnutcultivation.

Table3.Constraints faced by the Groundnut growers regarding technological support (n=120)

Sl.no	Constraint	Strongly agree	Agree	Disagree	Mean	Rank
i)	Insufficienttrainingfor knowledgeand skill enrichment	78	40	2	2.63	I
ii)	Noexposurevisittogain experienceandconfidence	62	53	5	2.48	II
iii)	Notdistributingreference materials	0	58	62	1.48	VII
iv)	Insufficientguidanceand expertise	1	56	63	1.46	IX
v)	Lackofcompetencyofthe fieldstaffs	0	56	65	1.47	VIII
vi)	Extensionofficialsnot cooperative	1	62	57	1.53	V
vii)	Inadequatedemonstration& fielddays	62	39	19	2.36	III
viii)	Noclarificationofdoubts	0	59	61	1.49	VI
ix)	Noregularmonitoring& supervision	0	66	54	1.55	IV

(Maximumobtainablescore-3)

3.3 Constraints faced by the Groundnut growers regarding service & supply:

Timely application of required inputs regulates crop stand along withproduction and productivity. The farmers therefore required timely availability of required inputs in their locality. The extension officials need to liaison with the input supplier fortimelysupply of required inputs and materials. The departmental input supply must bemade available to the growers in time. The constraints stated by the respondents on service andsupplyhavebeenindicated in table4.

The respondents had cited the constraints of notensuring availability of choice- able varieties, insufficient attempt inpre- arrangement ofinputsand materials alongwith custom hiringservicesin useofimplements. Qualityseedsofchoice-ablevarietyensuregoodgerminationandcropgrowth.Theinputsshouldbeavailablesufficientlyahead ofthecropsowingsothatthe respondents can reserve the seeds and other inputs for timely sowing. Each farmer cannotpurchase various implements and machinery for use in land preparation, weeding, hoeing,harvesting and pod detachment. Mechanism needs to be developed in each village toprovidecustomhiringfacilityserviceenablingthefarmertouseimplementsandmachineries with affordable charges. The extension officials working in the study areahave to analyze all these constraints and take necessary steps to extend necessary facilitiestogroundnutgrowers forsuccessfulcrop raising.

Table4.Constraints faced by the Groundnut growers regardingservice &supply

(n=120)

Sl.no	Constraint	Strongly agree	Agree	Disagree	Mean	Rank
i)	Not ensuring availability of choice able variety	4	62	54	2.47	II
ii)	Not liasoning for supply of quality seeds.	63	50	7	1.64	VII
iii)	Not liasoning with dealers for timely supply of required inputs	7	75	38	1.74	V
iv)	Not ensuring authenticity of available plant protection chemicals	4	78	38	1.71	VI
v)	Insufficient knowledge & skill in use of feasible implements	18	71	31	1.89	IV
vi)	Custom hiring service not available in the locality	69	40	12	2.49	I

(Maximumobtainablescore-3)

3.4 Constraints faced by the Groundnut growers regarding monitoring & supervision:

Closemonitoring, supervision,timelyguidanceexpertise,resourcemobilization, conflict resolution and immediate solving of field problems etc. are the keyindicatorsforsuccessfulraisingofgroundnut crops.Therefore,propermonitoringandsupervision are essential in harvesting good crop, as well as good yield in groundnut. Theconstraints stated by respondents in monitoring and supervision by the field functionarieshavebeen analyzedandpresented inTable -5.

As observed from the table, the majority of the respondents had strongly agreed for the statements - timely guidance and expertise as well as no immediate action of field problems. At thesame time, the majority of the respondents had also agreed for no regular diagnostic visit, noclosemonitoringandsupervision,resourcemobilization,notliaisingfortimelyavailability of inputs and interest for timely operation all practices. The mean score valueindicated that not being given timely guidance and expertise and no immediate action on fieldproblemswerethemajorconstraintsin monitoring and supervision. The findings therefore suggested that the extension officials promoting groundnutcultivation in the study area must analyse these two constraints identified and takenecessarysteps to provideall feasiblesupports tothegroundnut growers.

Table- 5: Constraints faced by the Groundnut growers regarding monitoring and supervision (n=120)

Sl. No	Constraint	Strongly agree	Agree	Disagree	Mean Score	Rank
i)	Noregulardiagnosticvisits	3	75	42	1.67	III
ii)	Timelyguidanceandexpertise notgiven	69	42	9	2.50	I
iii)	Noclosemonitoring &supervision	38	70	12	1.58	V
iv)	Not involving relateddepartmentsforre source mobilisation	2	67	51	1.59	IV
v)	Not liasoningfortimelyinput Availability	2	64	54	1.56	VII
vi)	Nointerest fortimelyoperation ofallpractices	0	68	53	1.57	VI
vii)	Noimmediateactiononfield Problems	62	34	24	2.32	II
viii)	Notinvolvinginconflict Resolution	0	47	73	1.39	VIII

(Maximumobtainablescore-3)

3.5 Constraints faced by the Groundnut growers regarding credit and finance facilities:

The farmers required considerable investment in purchasing seed, fertilizer andplant protection chemicals. They might need credit facilities. The respondentstherefore asked as mentioned the constraints faced by them on credit and finance. The datacollectedhasbeenanalyzedandobtainedresultsreflectedinTable- 6.

Asobservedfromthetable,majorityoftherespondentshadagreedfornotliasoningwithcreditinstitution, notsanctioningrequiredamount,harassmentinprocessingdocuments,nofixinginstalmentsasperpay ingcapabilityaswellasnoinsurancecoverage.Themeanscorevalueindicatedthattherespondentshav efacedconstraints of the harassment in processing of documents, required amount not sanctioned,no consideration in guarantee and no subsidy facility. Otheraspects of credit and financementioned in the table might not be considered as major constraintsconsidering a low meanscore value. However, the extension officials must analyse all theopinions of therespondentsandprovide feasiblesupportforeasyavailabilityof creditfacility.

Table-6:Constraintsfacedby the Groundnut growers regardingcreditandfinancefacilities

` **(n=120)**

Sl.No	Constraint	Strongly agree	Agree	Disagree	Mean score	Rank
i)	Notliaisoningwithcredit institutiontosanctionloan	0	77	43	1.64	VII
ii)	required amountnot sanctioned	55	65	0	2.45	II
iii)	Harassmentinprocessingof Documents	56	63	1	2.46	I
iv)	Notfixinginstalmentsasper paying capability	20	77	23	1.97	V
v)	Noconsiderationin guarantee	39	67	14	2.20	III
vi)	No subsidyfacility	31	66	23	2.06	IV
vii)	Noinsurancecoverage	21	68	31	1.91	VI

(Maximumobtainablescore-3)

3.6 Constraintsfaced by the Groundnut growers regardingharvestingandpostharvesting activities

Timely harvest of groundnut particularly at 80% pod maturity decreases loss ofpods. Since harvesting is labour consuming, use of implements will be beneficial. Properdrying, bagging and storing reduces. Crop damage in storage. The respondent thereforeasked to mention the constraints faced in harvesting and post harvesting management.ThedatacollectedinthisregardhavebeenpresentedinTable-7afteranalysis.

As observed from table 7, most of the respondents had strongly agreedfor adequate space for proper drying. Majorityof the respondents also agreed to skill deficiency in use of implements, proper drying, quality maintenance ofthe produce during harvesting, no community drying facilities, poor knowledge on properstoring as well as no insurance for storage loss. However, the mean score value indicatedthat the respondents had faced many constraints on no adequate space for proper drying. Itis therefore suggested that community drying yard facilities may be created along withguidancefortimelyharvest and adequateknowledgeon qualitymaintenance.

Table-7: Constraints facedby the Groundnut growersregarding harvesting and post harvesting activities:

(n=120)

Sl.No	Constraint	Strongly agree	Agree	Disagree	Mean score	Rank
i)	Noguidancefortimelyharvest	38	46	36	2.01	II
ii)	Skilldeficienciesinuse of Implements	26	62	32	1.95	VI
iii)	Poorknowledgeon quality maintenance	29	63	28	2.00	III
iv)	Poorsoil moistureduring Harvesting	19	58	43	1.8	VIII
v)	Noadequatespaceforproper Drying	59	44	17	2.35	I
vi)	No communitydryingfacility	29	60	31	1.98	V
vii)	Poorknowledgeonproper Storing	28	60	32	1.96	IV
viii)	Noinsurance coveragefor storageloss	26	56	38	1.9	VII

(Maximumobtainablescore-3)

3.7 Constraintsfacedby the Groundnut growersregardingmarketing activities:

Easy disposal of produce particularly after harvest may eliminate the constraintsof storage loss. The respondent should be appraised about the market price regularly.Cooperativesystem of procurement is also beneficial for the growers. The datacollectedinthisregard havebeenpresented inTable-8afteranalysis. As observed from the table, majority of the respondents were strongly agreed fornot guiding the growers to collect market information, no minimum support price of theproduce, immediate disposal of produce, exploitation by the traders and businessmen.The majorityof the respondents were also agreed and stated the constraints of no idea aboutmarketing information, no cooperative system of procurement, no transparency in gradingand measurement as well as no immediate payment.It is indicated that the respondentshad constraints in almost all aspects of marketing as mentioned in the table. However, therespondents had more of constraints on no immediate payment, exploitation of traders andbusinessman,notliaisoningforimmediatedisposaloftheproduce,noreasonableminimum support price, not guiding to collect market information considering ofmeanscorevalue.It is therefore suggested that officials of the state department of Agriculture

havetoanalyseallthesecons traintsandtakefeasiblestepstominimizethesecons traints, enabling therespondents to dispose oftheproducewithbetterprices.

Table-8:Constraintsfacedby the Groundnut growers regardingmarketing activities (n=120)

Sl.no	Constraint	Strongly agree	Agree	Disagree	Mean score	Rank
i)	No idea about marketinginformation	0	67	53	1.55	VIII
ii)	Notguidingtocollectmarket Information	62	42	16	2.38	V
iii)	No reasonable minimum supportprice	65	49	6	2.49	II
iv)	Notliaisoningforimmediate disposaloftheproduce	78	38	4	2.62	I
v)	No co-operative system in Procurement	29	71	20	2.07	VII
vi)	Exploitationbythetraders& Businessmen	71	33	16	2.47	III
vii)	Notransparencyingrading& Measurement	39	62	19	2.16	VI
viii)	Noimmediatepayment	56	64	0	2.46	IV

(Maximumobtainablescore-3)

Similar studies identified the following problems of groundnut productivity - lack of better varieties, lack of agricultural credit, a lack of production tools, high seed and fertiliser prices, drought, and disease [9].Other groundnut production constraints included poor soil fertility, a lack of access to improved seed, pre-harvest diseases, the use of low yielding varieties, insufficient access to extension services, limited access to credit, and a scarcity of improved varieties. Farmers chose qualities such as high shelled yield, early maturation, drought tolerance, market value, good seed quality, flexibility to local growing conditions, and disease resistance [10].

4. CONCLUSION

Balasore district of Odisha has great potential in groundnut cultivation. The farmers have also affinity to grow groundnut for better income generation. However, the productivity of the groundnut has been deteriorating year after year. It indicates that the farmers are facing in convincing on various aspects of crop raising including harvesting and marketing. Hence the extension functionaries involved in promotion of groundnut cultivation including administrators and executives must take all possible steps

to solve all these deficiencies, for the betterment of the groundnut growers. The study may be conducted in larger area involving a greater number of farmers from other blocks of the district for developing strategic action plan for better production and productivity. The study may be extended to other groundnut districts of the state to develop need-basedaction plan for the betterment of farmers in particularly groundnut growers in the state. Some specific research particularly on varietal replacement, cultural practices, diseases and pests' management and marketing may be undertaken to develop strategic action Plan for promotion of groundnut cultivation in Odisha. Research may be carried on group organization, leadership development and flow of information timely for effective monitoring and supervision.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. FAO (2002). Groundnut Post-harvest Operations.
2. Sori O. Factors affecting groundnut market supply in Western Oromia, Ethiopia. Heliyon. 2021 Jan 6:7(1) https://doi:10.1016/j.heliyon.2020.e05892
3. Konate, M., Sanou, J., Miningou, A., Okello, D. K., Desmae, H., Janila, P., & Mumm, R. H. (2020). Past, Present and Future Perspectives on Groundnut Breeding in Burkina Faso. *Agronomy*, *10*(5), 704. https://doi.org/10.3390/agronomy10050704
4. Naik, A. K., Pallavi, N., &Sannathimmappa, H. G. (2018). Performance of different Spanish-Type groundnut varieties suitable under Central dry zone of Karnataka, India. *International Journal of Current Microbiology and Applied Sciences*, *7*, 1394-1397.
5. Naidu, K. G. K Narendra, and Ram Chandra. 2023. "Estimation of Costs and Returns of Groundnut in Vizianagaram Districts of Andhra Pradesh, India". *Journal of Experimental Agriculture International* 45 (10):1-5. https://doi.org/10.9734/jeai/2023/v45i102194.
6. Sairam M., Lalichetti S. & Reddy, M.D. (2022). Estimation of water requirement and irrigation schedule for groundnut and sunflower crops in southern Odisha using FAO CROPWAT8.0 model. *Journal of Agrometeorology*, *24*(3), 309–311. https://doi.org/10.54386/jam.v24i3.503
7. Ramachandran R, Silva L, Udayanga NWBA. (2021). Level of Technology Adoption in Groundnut (Arachis hypogeae L.) Production: A Case Study in Batticaloa District. Applied Economics & Business.5,76. https://doi.org/10.4038/aebv5i2.39
8. Burigi, Sushmitha, K. N. Selvaraj, R. Senthil Kumar, S. Senthilnathan, S. Moghana Lavanya, and U. Arulanandu. 2023. "Assessment of Growth Pattern and Intervention's Effects of Oilseeds Mission on Groundnut Production in Andhra Pradesh, India". *Journal of Experimental Agriculture*

International 45 (7):82-92. https://doi.org/10.9734/jeai/2023/v45i72136.

9. Sinare, B., Miningou, A., Nebié, B. *et al.* Participatory analysis of groundnut (*Arachis hypogaea* L.) cropping system and production constraints in Burkina Faso. *J Ethnobiology Ethnomedicine* **17**, 2 (2021). https://doi.org/10.1186/s13002-020-00429-6
10. Abady, S., Shimelis, H., & Janila, P. (2019). Farmers' perceived constraints to groundnut production, their variety choice and preferred traits in eastern Ethiopia: implications for drought-tolerance breeding. *Journal of Crop Improvement*, *33*(4), 505–521. https://doi.org/10.1080/15427528.2019.1625836
11. Giri PP, Mohanty BK, Acharya S, Das SP, Kumar B. Influence of Socio-economic Attributes of Groundnut Growers on Adoption of Various Farm Practices in Balasore District of Odisha, India. J. Sci. Res. Rep. [Internet]. 2024 Mar. 22 [cited 2024 Dec. 19];30(5):369-75. Available from: https://journaljsrr.com/index.php/JSRR/article/view/1952
12. Yenagi, B. S., and Rohini R. Sugandhi. 2024. "Evaluation of High Yielding Groundnut Varieties for North Transitional Zone of Karnataka State, India". International Journal of Plant & Soil Science 36 (6):770-75. https://doi.org/10.9734/ijpss/2024/v36i64682.