INTERNATIONAL JOUNAL OF: AGRICULTURAL RESEARCH AND BIOTECHNOLOGY

TIMBOU-AFRICA ACADEMIC PUBLICATIONS
INTERNATIONAL JOURNAL, MAY, 2023 EDITIONS
VOL. 13 NO. 1 ISSN: 3438-2901

EFFECT OF INDO LEACETIC ACID ON THE GERMINATION RATE AND SEEDLING GROWTH OF *GLYCINEMAX*L. MERRILLIN (SOYBEAN)

[1]UMEOKA, N.; [2]EGBUCHA, K. C.; & [3]NZENWA, P. O.

[1]Department of Plant Science and Biotechnology (Botany), Faculty of Biological Sciences, Imo State University, Owerri, Imo State. [2]Department of Plant Science and Biotechnology (Botany), College of Natural Science, Michael Okpara University of Agriculture, Umudike, Abia State. [3]Department of Animal and Environmental Biology, Faculty of Biological Sciences, Imo State University, Owerri, Imo State.

ABSTRACT

The effect of Indole-3-Acetic Acid (IAA) was carried out on the germination and seedling growth of *Glycinemax* L. Merrillin (soybean). The seeds of soybean were pre-soaked in different concentrations of IAA: 50ppm, 100ppm, 150ppm, 200ppm and 0ppm (control) .After two days of planting, germination was

Introduction

Glycinemax L. Merrillin (soybean) is a highly nutritive and energy rich rainy season monocarpic legume crop with biologically effective proteins (40-42%), edible oil (20%), vitamins, salts and essential amino acids. It is popularly known as "Miracle Bean" because of its versatility and is being exploited in many agro-based industries within numerable ways. It can be grown in a wide range of climate and on a variety of soil. *Glycinemax* L. Merrillin legume is one of the most important oil crops in the

observed in all the treatments. From the results obtained Final Germination Percentage (FGP), the highest was in 0ppm (96.67%) followed by 100ppm (93.33%), 50ppm and 150ppm (90%) and the least 200ppm (83.33%). The Mean Germination Time (MGT) was minimum in 0ppm (2days) and maximum in 50ppm (2.89 days). Germination Rate Index (GRI) was maximum in 0ppm (48.33%) and minimumin 200ppm (34.17% days). Among the IAA concentrations, 100ppm gave better germination results. The radicle length was longest in 0ppm (21.33mm) and shortest in 150ppm (9.66mm). With 13.15mm long, 100ppm has the second best length of radicle. Number of roots per plant was 11.25 in 0ppm (maximum) and 3.62 in 150ppm (minimum). Number of plants with leaf emergence showed 100ppm which had the highest number, while no leaf was observed in 0ppm. The pretreatment of soybean seeds can enhance the germination and seedling growth. The IAA application (concentration) should be moderate so as to obtain the best outcome.

Keywords: Effect, Indole-3-Acetic Acid, Germination, Seedling growth, *Glycinemax* L. Merrillin (Soybean).

world, and is an important source of plant oil and protein for human consumption (Xu,2015). Timely germination and uniform seedling emergence of soybean from the soil under natural field conditions are crucial to high yield. On the other hand, the seeds of soybean possess high oil and protein concentrations, compared to cereal crops such as wheat and rice. Wang *etal.,* (2012) and Dargahi and Srinives (2014) noted that the oxidation of oil and protein causes seeds to deteriorate during storage, resulting in decreased soybean seed germination and seedling emergence in the field. On the other hand, the pre-harvest sprouting of soybean seeds also causes significant reductions in soybean yield and quality, especially under conditions of high temperature and humidity (Shu*etal.,* 2015). Combined with the rigid and impermeable seed coat of soybean, these limitations constrain soybean seed quality (Ling, 2014), and can negatively affect soybean seed germination. Consequently, investigations of the

physiological and molecular mechanisms underlying soybean seed germination is of both applied and fundamental relevance.

Shuetal., (2015) stated that seed germination is a key stage during a plants lifecycle and the germination process is determined by diverse environmental cues, such as the availability of suitable levels of light, water and oxygen, as well as the presence of endogenous phyto hormones and Abscisic acid (ABA) promotes seed dormancy and thus inhibits seed germination, while Gibberellins (Gas) release seed dormancy and promote seed germination. These are the key hormonal regulators of seed dormancy and germination, and have been very well studied over past decades according Nee *etal.,* (2016); Graeber *etal.* ,(2012) and Finkeistein *etal.,* (2008).

The increasing importance of soybean as food crop in Nigeria calls for effort to increase its enterprise or production. Very limited work has been carried out regarding the use of IAA in soybean production in Nigeria. However, the study on the effects of IAA and its climatic conditions could provide useful information regarding to the manipulation of growth and improvement of the yield. The aim of the study was to evaluate the effects of Indole-3-acetic acid (IAA) on the growth and development of *Glycinemax* L. Merrillin in order to determine the optimum concentration required for the growth and development; and to investigate the effect of different concentrations of IAA on germination rate and seedlings development of *Glycinemax* L. Merrillin.

MATERIALS AND METHODS

Study area

The research was carried out in the Department of Plant Science and Biotechnology Laboratory, Imo State University, Owerri, Imo State, Nigeria. It is situated between latitude 4^{0} 45^{1} 5.5037^{0}N and 7^{0} 15^{1} 6.453^{0} N and longitude 6^{0} 50^{1} 7.0438^{0} E and 7^{0} 25 ^{1}8.1330^{0} E. The anannual rainfall of about 2500mm, temperature range from 270C to 300C with a relative humidity of 75%.

Seed collection

Seed of soybean (tax 1448-2E) (*Glycinemax*) were obtained from the Agricultural Development Programme (ADP) Okigwe road, Owerri city, Imo State. TAX 1448-2E were selected for the experiment because the seeds are

best among the other varieties of soybeans due to its high yield, early maturity, low shattering and high oil content.

Dilution of Indole Acetic Acid (IAA)

The IAA solution was prepared by dissolving 1g of IAA crystal in 3 ml of ethanol. 1000ml of distilled water was added to the solution to form a stock. The stock was then serially diluted to obtain five (5) different concentration of IAA: 0ppm, 50ppm, 100ppm, 150ppm and 200ppm. 0ppm which was the control had no IAA.

Treatment of Seeds

The seeds were sterilized after weighing using 70% ethanol in 200ml conical flask for 5 minutes and were drained for incubation.

Incubation of Seeds

After drying for 48 hours, the seed were sown on moist filter paper in well labeled petridishes. Into each petridish, 30 seeds were sown in each concentration and these were replicated 3 times making a total of 15 samples. The petridishes were covered and left by the window side of the laboratory. The seeds were checked at intervals and moisture regularly with water. Each replicates were been measured and calculated at 2 days interval to check the germination rates. Observations were made for 7 days during which germinated seeds were been recorded. This was maintained for a period of 3 weeks after which growth of seedlings were been measured using a meter rule.

Experimental Design

The experimental design was laid out in a completely randomized design. All percentage were been transformed prior to analysis. Data obtained were subjected to two ways ANOVA in randomized block design.

MeasurementofGrowthParameters

MeasurementonGermination

Measurement on germination include: Final Germination Percentage (FGP), Mean Germination Time (MGT), the Germination Index (GI), the Germination Rate Index (GRI), First Day of Germination (FDG), Last Day of Germination (LDG), and Time Spread of Germination (TSG).

Other growth measurements are number of roots. Radicle length and leaf appearance.

RESULTS

The results of the effect of IAA concentrations on germination of soybean were presented in Table 1 and Table 2. The Mean Germination time was 2.89 days in 50ppm, 2.36 days in 100ppm, 2.44 days in 150ppm, 2.72 days in 200ppm and 2 days in 0ppm. Germination Rate Index (GRI) was 36.67%/day in 50ppm, 42.48%/day in 100ppm, 35%/day in 150ppm, 34.17%/day in 200ppm while 48.33%/day in 0ppm. The First Day of Germination (FDG) was recorded in all the IAA solutions as 2days after planting. Last Day of Germination (LDG) was 6 days in 50ppm, 2days in 0ppm but 4 days in 100ppm, 150ppm and 200ppm respectively. The Time Spread of Germination (TSG) was observed to be 4days in 50ppm, 0 days in 0ppm but 2days in 100ppm, 150ppm and 200ppm. Final Germination Percentage (FGP) showed 50ppm and 150ppm had 90%, 100ppm had 93.33%, 200ppm had 83.33% while 0ppm had 96.67%.

Also the length of radicle was 13.15mm for 50ppm, 12.95mm for 100ppm, 9.66mm for 150ppm, 9.83mm for 200ppm while 21.33mm was for 0ppm. The average number of roots was 6.62 for 50ppm. 6.72 for 100ppm, 3.62 for 150ppm, 3.94 for 200ppm and 11.25 for 0ppm. The number of plants with leaves emerged was 1 for 50ppm and 200ppm, 5.5 for 100ppm, 2 for 150ppm while for 0ppm.

Table1: Germination Parameters of Soybeans soaked in different Concentrations of IAA

Parameter	0ppm	50ppm	100ppm	150ppm	200ppm
MGT(day)	2	2.89	2.36	2.44	2
GRI(%/day)	48.33	36.67	42.48	34.17	48.33
FDG(day)	2	2	2	2	2
LDG(day)	2	6	4	4	2
TSG(day)	0	4	2	2	0
FGP(%)	96.67	90	93.33	83.33	96.67

Table2: Seedling growth of Soybeans soaked in different concentration IAA

Parameter	0ppm	50ppm	100ppm	150ppm	200ppm
Length radicle	21.33	13.15	12.95	9.66	9.83
No% roots	11.25	6.62	6.72	3.62	3.94
Leaf emergence	0	1	5.5	2	1

Discussion

Priming of seeds as a technique has been adopted to improve germination of seeds (Lavissa *etal.*, 2015). When pre-soaked, the germination process is induced by soaking seeds in water or in solution containing exogenous molecules such as salts (Khan etal., 2009), metal (Mirshekari etal., 2012) or hormones (Mshelmbula *etal.*, 2015). Golezani and Moghaddah (2008) reported that presoaking in water increased the weight of the seedling root, the germination rate, shoot, root and seedling dry weight. In the study, the highest value for Mean Germination Time (MGT) was in 50ppm (2.89 days) and the least was in 0ppm (2days). The lower the mean germination time (MGT), the higher and faster germination occurred. Thus, germination of more seeds occurred in control than the IAA treatment. Among the IAA concentrations, 100ppm (2.36day) had lower mean germination time and will be suitable for soybeans. The Germination Rate Index (GRI) was maximumin 0ppm (48.33%/day) followed by 100ppm (43.48%/day) but the minimum was in 200ppm, (34.17%/day). The control (0ppm) was also faster in germination per day, followed by 100ppm. Soybean required moderate quantity of IAA solution to germinate higher and faster. In all the treatments, it was observed that germination occurred on the second day after planting. Germination was completed on that same day for 0ppm while it took more days in IAA treatments. The longest time for germination to complete was recorded in 50ppm (6 days after planting).

This indicates that very lower concentration of IAA may not enhance germination of soybeans when soaked. The best percentage of germination was observed in control (0ppm–96.67%) followed by 100ppm (93.33%) while the lowest was in 200ppm (83.33%). Although more than 50% germination occurred in all the treatments, the control was better when compared with IAA solutions. Also, 100ppm which in a moderate concentration showed its

influence on the germination percentage, thus, proved more preferred treatment interms of IAA application.

Furthermore, seeds treated with 0ppm showed longer radicle lengthth another treatments. The radicle length was observed to decrease with increase in concentration. This agrees with the finding of Chaudhry and Khan (2009) who reported decrease in length of radicles of black gram and Horse gram treated with IAA as the concentration increased. Among the IAA treatments, 50ppm favored radicle length as it was longer than in other IAA solutions. Seeds presoaking in 0ppm also has the maximum number of roots perplants while the minimum was recorded in 150ppm. The control seems to be favorable interms of seedling growth on the leaf emergence perplant, no leaf was observed in 0ppm within the period of this study. But more leaves were observed in 100ppm. The presence of more leaves in 100ppm further strengthens the fact that soybeans trives more in moderate concentration of IAA than in higher or lower concentration.

Conclusion and Recommendation

Seed priming with different concentrations of IAA can be successfully applied to improve the germination of soybeans seeds. The results indicated that priming of seeds is considereded best at 100ppm concentration of IAA apart from control and other IAA were able to germination more than 50% of the seeds. Therefore, priming of soybeans can improve its production

Apart from IAA and GA, there are other growth hormones more that can be used for germination. Results of the study have proven the effectiveness of IAA in germination of soybeans. Therefore, I recommend the application of other hormones or salts or metals solution in germination of soybeans.

References

Chaudhry,N.Y.andKhan,A.S.(2009).Effectofgrowthhormone,GA_3,IAAandKinetinonlengthanddiameterofshort,earlyinitiationofcambiumandmaturationofmetaxylemelementin*Cicerarientium*L.Pak.*J.Biol.Sci.*3;1263-1266.

Dargahi,H.T.P.andSrinives,P.(2014).Mappingofthegenomicregionscontrollingseedstorabilityinsoybean(*Glycinemax*L.).*J.Genet.*93;365-370.

Finkeistein,R.,Reeves,W.,Ariizumi,T.andSteber,C.(2008).Molecularaspectofseeddormancy.*Ann.Rev.PlantBiol.*59:387-425.

Golezani,K.A.V.andMoghaddah,M.(2008).Effectofdifferentprimingtechniquesonseedinvigorationandseedlingestablishmentonlentil(*Lensculniarismedik*).*JournalofFoodAgricultureandEnvironment*.6(2):222-226.

Graeber,K.,Nakabayashi,K.,Miatton,E.,Leubner-Metzger,G.andSoppe,W.(2012).Molecularmechanismsofseeddormancy.*PlantCellEnviron.*35:1769-1786.

Khan,A.,Wani,P.A.andOves,M.(2009).RoleofplantgrowthpromotingRhizobacteriaintheremediationofmetalcontaminatedsoils.*Environ.Chem.*12:235-240.

TIJARBT
ISSN: 3438-2901

Lavissa,S.Aiwansoba,R.O.andOsawaru,M.E.(2015).EffectofIndoleaceticacidonagerminationof*Citrulluslanaatus*.*AcehInternationalJ.ScienceandTechnology*.4(3):107-113.

Ling,L.(2014).Effectofcoldplasmatreatmentonseedgerminationandseedlinggrowthofsoybean.*Sci. Rep*.4:5859.

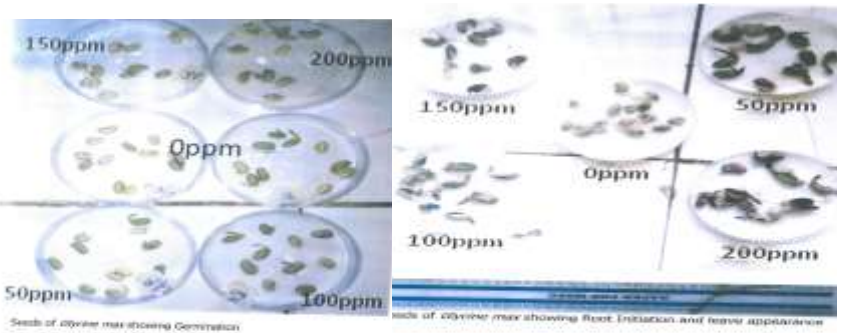
Mirshekari,B.,Hokmalipour,S.,Shoarifi,R.S.,Farahvash,F.andGadim,A.(2012).Effectofbioprimingwith PlantGrowthPromotingRhizobacteria(PGPR)onyielddrymatteraccumulationofspringbarley(HordeumvulgareL.).atvariouslevelofNitrogenandPhosphorusfertilizer.*JournalofFoodAgric.Environment*.10:314-320.

Nee,G.,Xiang,Y.andSoppe,W.J.(2016).Thereleaseofdormancy,awake-upcallforseedstogerminate.CuffOpin*PlantBiol*.35:8-14.

Shu,K.,Liu,X.D.,Xie,Q.andLe,Z.H.(2015).TwoFacesofOneSeed:HormonalRegulationofDormancyand Germination.Mci.Plant.2016:9:34-45.Shu,K.Dormancyandgermination:Howdoesthecropseeddecide?*PlantBiol*(Stuttg)17,1104-1112.

Wang,L.,Ma,I.I.,Song,L.,Shu,Y.andGu,W.(2012).Comparativeproteomicsanalysisrevealsthemechanismofpre-harvestseeddeteriorationofsoybeanunderhightemperatureandhumiditystress.*J.Proteomics*,&5:2109-2127.

Xu,X.P.(2015).Integratedandcomparativeproteomicsofhigh-oilandhighproteinsoybeanseeds.*FoodChem*.172:105-116.



Development of radical and plumle initiation
Effect of different IAA concentration on germination rate of soybean (*Glycine max*)