Treatment of Seeds Using Essential Oils of Scented Lemongrass, *Curcuma xanthorrhiza*, and Nutmeg on the Viability of White Corn (*Zea mays ceratina* L.)

Purwanto Purwanto[1*], *Ni Siluh Putu* Nuryanti[1], and *Oktafrina* Oktafrina[1]

[1]Lampung State Polytechnic, Lampung, Indonesia

Abstract. Seed is a determining factor in cultivation. To maintain seed quality, it is necessary to have a new breakthrough in seed treatment, namely, the use of plant essential oils. Essential oils contain compounds that can repel, kill, and inhibit the development of destructive pests, chemical and semi-chemical components in the form of pheromones, and allelochemicals. This research was conducted to obtain the concentration of essential oil, which is most suitable as a seed protector, before planting to avoid damaging pests and seed-borne pathogens. The research was carried out at the Plant Laboratory 1 of the Lampung State Polytechnic using a randomized completely block design (RCBD), and a further test of the difference that is least significant (LSD) was carried out at the five percentiles. The concentration of essential oils K1:2%, K2:4%, K3:6%, and K0 : control. K0: control. Each concentration was repeated three times. The concentration of 2% (K2) can potentially protect the seed compared to lemongrass and nutmeg at all three concentrations. The use of nutmeg and citronella essential oils at three concentration levels directly affects germination, as seen from the observed indicators of root length, hypocotyl length, strong normal sprouts, weak normal sprouts, abnormal sprouts and dead seeds. This is thought to be due to their high allelochemical content. However, the essential oils of nutmeg and citronella can still be used as a seed treatment with low concentrations of seeds. It is necessary to carry out a vigour test to determine its effect directly in the field so that the most appropriate concentration and application method are obtained in an effort to minimize the effect of allelochemical content on seed growth but still able to protect seeds from destructive pests during the germination period in the field.

1 Introduction

Corn is the principal dish ingredient for Indonesian citizens besides rice. The requirement for corn as a raw material for food, feed and industry continues to increase. Corn contains essential fats that are not found in rice and have the benefit of preventing blood vessel

* Corresponding author: purwantopoltek@gmail.com

constriction [1]. During storage, corn seeds are often damaged due to warehouse pests (*Sitophilus zeamais*). The damage causes the seeds to be hollow, easily broken and become flour. One way to control it is to use essential oils that contain compounds that are able to repel, kill and inhibit the development of destructive pests [2]. Temulawak essential oil contains curcumin, phellandrene, turmerol, camphor, glucoside, carbinol, xantorizol, and oleoresin [3]. Meanwhile, the main ingredients in citronella essential oil are citronellal, citronellol and geraniol [4]. Citronella essential oil components have repellent and insecticidal properties against *Sitophilus granarius* insects, so they might be able to control crop pest storage [5]. Nutmeg essential oil contains sabinene, α-pinene, cyclobutane, phellandrene, γ-terpinene, terpinolene, terpineol, safrene, and myristicin [6]. To protect the seeds from pathogens and destructive pests before planting the seeds can use the seed coating method using extracts of *lamtoro*, chitosan and betel leaf, with a mixture of the three ingredients, as much as 1% each extract giving the best effect based on the vigour index, growth potential and germination potential maximum [7].

According to Indriaty et al., soaking *Moringa* leaves at a concentration of 12% for 12 hours significantly affects the root system's length, and soaking time significantly affects seed viability [8]. The use of *tembelekan* leaves was able to maintain vigour and seed viability of 97.33% [9]. Essential oils can be a new option to control seed-borne pathogens as fungicides to protect seeds before and after planting [10]. Essential oils are an effective new strategy with a low risk of harm through chemical and semiochemical components such as pheromones and allelochemicals promising for insect pest and pathogen control. However, due to low chemical stability, weak water solubility, and easy degradation, a strategy is needed so that its biological and chemical properties do not change [11]. This research was conducted to obtain the most appropriate concentration and type of essential oil as a seed treatment before planting the seed.

2 Materials and methods

2.1 Essential oil manufacture

The research was conducted from March to May 2022 at the Plant Laboratory 1 of the Lampung State Polytechnic. The three essential oils were obtained using the direct distillation (steamed) method. First, the material was cleaned of dirt and then chopped to reduce the size. The material was air-dried and then refined using a disc mill if needed (depending on the type of material to be distilled). The material is to be distilled as it is ready, then put in a distillation steam pot and steamed until the oil drips along with the water vapour. The steaming time is different depending on the type of material being distilled. The essential oil is then separated using a separatory funnel. The result of the separation is put in a bottle with a lid to avoid evaporation.

2.2 Seed preparation

Conduct seed selection to obtain test materials that have uniformity in size and colour and are not damaged or deformed. Conduct a seed germination test to get initial seed germination.

2.3 Solution preparation

Preparation of the solution used the water into oil (A/M) method by using a magnetic stirrer with a rotation of 700 to 730 rpm for 30 minutes. The solution was made in three concentrations, namely K1 2%, K2 4%, and K3 6%, for the three essential oils: citronella

essential oils, nutmeg, and temulawak. The essential oil is taken in according to be made, then Tween 80 is added as an emulsifier with a ratio of 1:1. The mixture of essential oil and tween is stirred using a magnetic stirrer, slowly added distilled water until the volume reaches 100 ml and slowly the rotation is added up to 730 rpm for 30 minutes. The finished solution was immediately applied for seed treatment using the spray method.

2.4 Germination power test

Seed germination is a measure of seed viability, namely the ability of seeds to grow normally under optimum conditions [12]. The seeds were treated according to concentration by the spray method and then sown using three layers of moistened brown paper for the bottom and two layers for the top as a cover. The straw paper containing corn seeds was then rolled up in plastic sheets (UKDdP) and then put in a germination cabinet. Each concentration had three replications with three controls (K0), so there were 12 experimental units for each concentration treatment, so the total experimental unit was 36. Observations were made after the seeds had germinated for four days. Observation variables included hypocotyl length (PH), root length (PA), simultaneous germination (KSP), strong normal sprouts (KNK), weak normal sprouts (KNL), abnormal sprouts (KAN), and dead seeds (BM).

KSP is a sprout that grows normally, either normally strong or weak. KNK is a seed that usually grows and has better physical growth, as seen from the length of the hypocotyl and root length, which is longer than that of normal weak sprouts. Abnormal sprouts grow abnormally, as seen from imperfect growth, such as hypocotyl growing but not growing roots and vice versa, or both growing but experiencing growth inhibition. Meanwhile, dead seeds are seeds that show no signs of growth at all until the time of observation.

3 Results and discussion

Based on the result, the coefficient of variance showed that the concentration and type of essential oil used significantly affected the viability of white corn seeds. This could be seen from the hypocotyl length, root length, simultaneous germination, strong normal germination and dead seeds, as seen in Table 1.

Table 1. Analysis of the various treatment concentrations of essential oils using the spray method

Observation variable	Influence Essential oil	KK (%)
Hypocotyl length (cm)	**	14.85
Root length (cm)	**	19.08
Simultaneous germination	**	9.34
Strong normal sprout	**	11.83
Weak normal sprout #	tn	50.58
Abnormal sprout #	tn	46.55
Dead seed #	**	24.09

Note: KK coefficient of variance, **= significant variation at 0.01 and * significant differences at 0.05, however significantly different at 0.01, # Data is transformed by the formula (x+0.1)

Table 2. Root length, hypocotyl length, KSP and KNK with treatment of essential oil concentration by spray method

Atsiri	Long Root	Length hypocotyl	KSP	KNK
PL0	9.34±87 ab	6.08±0.66 bc	23.33±0.58 a	22.33±1.53 a
PL2	6.09±1.04 c	4.22±1.16 de	22.33±1.15 a	20.33±2.31 ab
PL4	6.33±2.71 c	3.65±0.54 e	22.00±1.73 a	20.33±0.58 ab
PL6	6.32±2.07 c	4.21±0.32 de	20.33±2.08 ab	19.67±3.21 ab
SR0	10.73±1.66 a	6.96±1.37 ab	23.00±1.00 a	20.67±1.15 ab
SR2	8.07±1.49 bc	6.17±0.49 bc	20.67±1.15 ab	19.33±1.15 ab
SR4	7.58±1.43 bc	5.23±0.81 cd	18.67±2.31 b	15.33±3.06 c
SR6	3.35±0.71 d	2.95±1.16 e	15.00±4.58 c	10.00±2.00 d
TL0	11.13±1.53 a	7.30±0.88 ab	23.33±0.58 a	22.33±1.53 a
TL2	11.47±0.75 a	7.62±0.24 a	22.67±0.58 a	20.00±1.00 ab
TL4	7.90±1.85 bc	6.27±0.70 abc	21.00±1.00 ab	18.00±4.00 bc
TL6	6.83±0.38 bc	5.07±0.57 cd	18.33±2.52 b	14.67±2.08 c

Note: Based on the BNT test at the 5% level, numbers that are followed by the same letter in the same column show that they are not significantly separate. TL0 (temulawak concentration 0%), TL2 (temulawak concentration 2%), TL4 (temulawak concentration 4%), TL6 (temulawak concentration 6%), SR0 (citronella fragrance concentration 0%), SR2 (citronella fragrance concentration 2%), SR4 (citronella concentration 4%), SR6 (citronella concentration 5%), PL0 (nutmeg concentration 0%), PL2 (nutmeg concentration 2%), PL4 (nutmeg concentration 4%), PL6(nutmeg concentration 6%).

The test results of three essential oils at different concentrations showed a significant interaction. The use of essential oils at a concentration of 2% showed no significant effect on the control, and this could be seen from the number of simultaneous germinations, hypocotyl length, root length and strong normal sprouts when compared to using essential oils of lemongrass and nutmeg at the same ratio.

Table 3. KNL, KAN, and BM with the treatment of essential oil concentrations with the spray method

Atsiri	KNL (WNS)	KAN (AS)	BM (DS)
PL0	1.00±1.00	1.00±1.00	0.67±0.58 cd
PL2	2.00±2.00	0.67±0.58	2.00±1.00 b

Atsiri	KNL (WNS)	KAN (AS)	BM (DS)
PL4	1.67±1.53	0.00±0.00	3.00±1.73 ab
PL6	0.67±1.15	2.33±2.52	2.33±0.58 ab
SR0	2.33±2.08	0.33±0.58	1.67±1.15 bc
SR2	1.33±1.15	1.33±0.58	3.00±1.00 ab
SR4	3.33±1.15	3.00±1.00	3.33±1.53 ab
SR6	5.00±2.65	2.33±3.21	4.33±1.15 a
TL0	1.00±1.00	1.67±0.58	0.00±0.00 d
TL2	2.67±0.58	1.67±0.58	0.67±0.58 cd
TL4	3.00±3.61	2.33±1.15	1.67±0.58 bc
TL6	3.67±1.53	2.67±1.53	2.67±0.58 ab

Note: Based on the BNT test at the 5% level, numbers that are followed by the same letter in the same column indicate that they are not significantly different. TL0 (temulawak concentration 0%), TL2 (temulawak concentration 2%), TL4 (temulawak concentration 4%), TL6 (temulawak concentration 6%), SR0 (citronella fragrance concentration 0%), SR2 (citronella fragrance concentration 2%), SR4 (citronella concentration 4%), SR6 (citronella concentration 5%), PL0 (nutmeg concentration 0%), PL2 (nutmeg concentration 2%), PL4 (nutmeg concentration 4%), PL6(nutmeg concentration 6%).

Table 3 showed a significant difference in the number of weak normal germination, abnormal germination and dead seeds at a concentration of 2% for the three essential oils. The use of essential oil at a concentration of 2% did not significantly affect the viability of the white corn seeds tested, as seen from the insignificant difference between the nutmeg control, 0% and 2% temulawak. There was an interaction between the type of essential oil and the concentration on the viability of the seed. This was in accordance with the study by Nurbaekah et al. [13] that found a significant effect between the dose and cultivar and clove oil on the germination percentage of green beans after three months of storage.

4 Conclusion

From the results of the germination test of white corn seeds using three essential oils of temulawak, nutmeg and citronella at three concentration levels, using temulawak essential oil, it may be concluded that a concentration of 2% did not significantly affect the simultaneous germination, root length, and hypocotyl length. In comparison, using nutmeg and citronella essential oils at three concentrations affected germination growth: root length, hypocotyl length, abnormal sprouts, and dead seeds. This was presumably due to the presence of high allelopathic substances in the two essential oils compared to oil. A suggestion is that nutmeg and citronella essential oils can still be used as seed protectors before planting with lower concentrations, and it is necessary to carry out a vigour test to determine their effect on growth in the field so that the right concentration is obtained for each essential oil.

References

1. S. Ceunfin, Savana Cendana **4**, 28–30 (2019)
2. T.A.N. Rahman, Pengaruh pemberian minyak atsiri terhadap mortalitas hama gudang (*Sitophilus zeamais*) dan viabilitas benih jagung (Doctoral dissertation, Politeknik Negeri Jember, 2020)
3. E.Y. Astarini, Review ekstraksi rimpang (*Curcuma xanthorriza*) menggunakan berbagai macam metode ekstraksi (Doctoral dissertation, Akademi Farmasi Surabaya, 2021)
4. Murni, L. Rustin, *Karakteristik kandungan minyak atsiri tanaman serai Wangi (Cymbopogon nardus L.)*, in Prosiding Seminar Nasional Biologi Di Era Pandemi COVID-19, September, 227–231, Indonesia (2020)
5. A. Plata-Rueda, G.D.S. Rolim, C.F. Wilcken, J.C. Zanuncio, J.E. Serrão, L.C. Martínez, Insects **11**, 1–13 (2020)
6. R. Astuti, Indonesian Journal of Laboratory **1**, 36-40 (2019)
7. S.K.W. Utari, Uji efektivitas seed coating berbahan dasar kitosan dan fungisida nabati dari ekstrak lamtoro (*Leucaena leucocephala*) dan daun sirih (*Piper betle*) untuk mempertahankan viabilitas benih jagung (*Zea mays* L.) (Thesis, University of Muhammadiyah Malang, 2019)
8. A.S. Indriaty, S. Alimuddin, A. Abdullah, AGrotekMAS Jurnal Indonesia: Jurnal Ilmu Pertanian **3**, 41-53 (2022)
9. A. Tefa, A.K. Klau, O.B. Kapitan, Savana Cendana **4**, 26–27 (2019)
10. M. Moumni, G. Romanazzi, B. Najar, L. Pistelli, H.B. Amara, K. Mezrioui, O. Karous, I. Chaieb, M.B. Allagui, Antibiotics **10**, 1–16 (2021)
11. A. Lucia, E. Guzmán, Advances in Colloid and Interface Science **287**, 102330 (2021)
12. Nurhafidah, A. Rahmat, A. Karre, H.H. Juraeje, Agroplantae **10**, 30–39 (2021)
13. S.S. Nurbaekah, S. Sumadi, A. Nuraini, Agrologia **7**, 288707 (2018)