Response of growth and yield of two soybean varieties to seed pre-treatment applications

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Abstract. Plant growth is influenced by seed quality. Seeds need to be treated to prevent pest and disease disorders or to increase seed germination. Soybean planting was carried out in this study by the treatment of varieties and seed pre-treatment application before planting. The study aimed to measure the growth and yield of soybeans by varieties and seed treatment before planting, carried out in the Village of Nggembé, District of Bolo, Bima Regency. The study used factorial randomized block design with two factors. The first factor was soybean varieties consisting of two levels, namely Devon and Dena varieties, and the second factor was the application of pre-planting seed treatments consisting of four levels namely Cruiser, Marshall, Agrisoy, and without seed treatment, each treatment was repeated three times. Observations were made on the performance of agronomic crops and soybean yields. The results showed that the treatment of soybean varieties and the application of seed treatment had a significant influence on plant height and soybean productivity, and both treatments had interactions on parameters of plant height, number of filled pods, weight of 100 seeds, and soybean productivity with the best results successively produced by a combination of Devon-Control, Devon-Marshall, Devon-Agrisoy, and Dena-Cruiser.

1. Introduction
Soya is one of national strategic commodity, consistently enhanced in order to increase national production. This effort is feasible through the use of best varieties and qualified seeds. [1] stated that soybean seeds can have a rapid decrease in viability and vigour. This can lead to low seed germination rates, thereby reducing the number of plant populations. Based on [2], the decline on the soybean population number was not only caused by failed seeds but also by seed flies.

Efforts to get uniform plant growth and to prevent pests attack at the early stage of growth, including seeds treatment or seeds coating. Seeds coating is an application of chemical compound as insecticides, fungicides, growth regulators or nutrients in seeds. This application is expected to increase seeds vigour when planned on field and way of early protection to prevent pests and diseases of plant. The Impact can be traced by plant growing and result achievement [3,4]. Other than chemical compound, biological agents can also be used as substance for seeds treatment to control of seed-borne insects and pathogens[5].
Research related to seeds coating for soybean has been carried out by [6] using biological agents of *Rhizobium* sp and *Azobakter* sp., and insecticides as thiamethoxam. Insecticides with active ingredients thiamethoxam can be applied and absorbed easily, soluble, and can protect seeds equally [3]. The existence of new superior varieties of soybean and seeds coating method thus it is necessary research about the application of seeds treatment to the new superior varieties. This research aimed to measure growth and yield of soybean by treating the soybean varieties and seeds treatment before planting.

2. Methods
This research carried out in drought I (DS I) started in March to May 2019 in Village of Nggembe, District of Bolo, Regency of Bima. This research used factorial randomized block design, consists of two factors: first, seeds treatment before planting and second, varieties of soybean, each treatment repeated for three times. Factor of seeds treatment consist of four levels which are the intake of Cruiser (A), Marshal (B), Agrisoy (C) and without seed treatment as control (D), while seeds treatment have two levels namely variety of Devon I and Dena I. These two varieties obtained from Balai Penelitian Aneka Kacang dan Umbi/Balitkabi, Malang.

This research consists of planting preparation, planting and maintenance, pest and disease control, and harvest. Planting preparation carried out without tillage. The rice straws from previous crop was left on the ground, and then flattened. Before planting, seeds were given a seed coating treatment based on recommended dosage in the package. Planting were carried out by means of hole with a depth of 2-3 cm, each planting hole was filled with 2 seeds, and 15x40 cm spacing. NPK 16:16:16 was applied with dosage of 100 kg/ha and 1 litre/ha of liquid fertilizer with 20% of active nitrobenzene. NPK (16:16:16) applied by spreading it before spreading of straw mulch, while liquid fertilizers was applied at the age of 20, 30, 45 and 60 days after planting (dap). Watering was carried out during flowering (30 dap), pods formation (45 dap), and pod filling (55 dap). Weeding was conducted 2 times, namely at 21 and 35 dap, while pest control carried out chemically. Harvesting was conducted when 75% (at a minimum) of leaves of the plants begin to turned yellow, dry and fall out and pods were brown. Harvesting was conducted by cutting stem bases. Sample was taken at 2x5 m sampling plot.

Plants growth observation variables were carried out during vegetative and generative phases included plants height, number of branches, number of leaves, number of nodes, and number of plant per clump. Observations of yield components consisted of number of filled pods, weight of 100 seeds and productivity. Data were taken from 10 sample plants in sampling plot for each treatment replication. The data obtained were then analyzed for variance (Anova) by using SAS 9.0. The treatment that had a significant effect, then followed by Duncan Multiple Ranges Test (DMRT) at $\alpha=5\%$.

3. Results and discussion
3.1. Agronomic performances
3.1.1. Plant height. Based on analysis of variance, soybean varieties and seed treatment gave a significant effect on plants height. Based on single factor of variety, soybean of Devon produced the highest plant height (55.6 cm) and was significantly different from Dena (50.4 cm) (Table 1). Meanwhile for seed treatment, Cruiser treatment (A) resulted in a higher plant height (56.6 cm) and was significantly different than others. There was a significant interaction between soybean varieties and seed treatments in Dena variety using Cruiser (58.4 cm). Different response showed by variety of Devon when seed treatments did not significantly affect plants height in both control and other seed treatments. This result indicated that soybean of Devon had a better adaptation than Dena because eventhough no seeds treatment, plants height is almost the same.
Table 1. Plants height of two soybean varieties (cm) using seeds treatment in the Village of Nggembe, District of Bolo, Regency of Bima in 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 54.7 ab     | 55.5 ab     | 54.4 ab     | 57.9 a      | 55.6 a  |
| Dena      | 58.4 a      | 51.1 bc     | 51.1 bc     | 45.2 d      | 50.4 b  |
| Average   | 56.6 a      | 53.3 b      | 50.6 b      | 51.6 b      |         |

Information: same letters on collums and rows show that there is no real different result based on DMRT \( \alpha = 0.05 \)

Variety of Devon had a better response in parameter of plants height. However when compared to varieties description made by [7], the value obtained was seems low. Application of insecticides resulted in a variety of plant height growth responses. Cruiser which produced the best plant height response contains the active ingredient thiamethoxam. Meanwhile, Marshal contained of active ingredient carbosulfan, and Agrisoy is biological agent consists of *Bradyrhizobium*. Thiamethoxam and carbosulfan had a function to protect plants from pest attack. According [8] thiamethoxam was used to control various important pests such as aphid, flies, tryps, leaf borer and species of Lepidoptera.

Other than their function as insecticide, Cruiser also had growth regulator to stimulate plants growth. Therefore, Cruiser treatment resulted the highest growth. Based on [4] showed that Cruiser treatment to Paddy Ciherang variety produced the highest plant and significantly different from control one, especially at 31dap. Meanwhile, Agrisoy treatment which was a Rhizobium biological agent, in this case produced the lowest result even thought it was not different than Marshal treatment and control. [9] stated that commercial Rhizobium inoculation in soybean plant in the field resulted in low nodulation, while the local Rhizobium could increase nitrogen fixation and soybean yields due to its ability to adapt to local conditions.

3.1.2. Number of nodes. The variety of soybean and seed treatment had no significant effect on the number of nodes and there was no interaction between soybean varieties and seed treatment. It showed that both varieties have a good response even though no seed treatment given. [10] stated that genotype of soybean which had a large number of fertile nodes gave higher seed yields and vice versa.

Table 2. Number of nodes on two soybean varieties using the seed treatments in Village of Nggembe, District of Bolo, Regency of Bima, 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 11.1        | 12.5        | 11.6        | 12.7        | 12.0    |
| Dena      | 12.3        | 12.1        | 11.8        | 11.8        | 12.0    |
| Average   | 11.7        | 12.3        | 11.7        | 12.3        |         |

3.1.3. Number of branch. Number of branch per plant was not influenced by soybean varieties or seed treatment. Dena produced the most number of branches (3.5) in the varieties treatment, meanwhile for seed treatment, the highest value obtained by control (3.5) (table 3). This showed that both soybean varieties did not need any application of seed treatment to produce a large number of branches.

Table 3. Number of branches per plan on two varieties of soybean using seed treatment in Village of Nggembe, District of Bolo, Regency of Bima, 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 2.4         | 3.2         | 2.3         | 3.2         | 2.9     |
| Dena      | 3.6         | 3.3         | 3.6         | 3.4         | 3.5     |
| Average   | 3.0         | 3.3         | 3.0         | 3.5         |         |
Different results made by [11] showed that soybean varieties had a significant effect on the number of soybean branches, and the number of branches had a positive correlation with seed weight per plant, plant height, number of pods, number of bunches, and number of seeds.

3.2. Soybean yield component

3.2.1. Number of pods per plant. Soybean varieties and seed treatment had no significant effect on the parameter of the number of filled pods per plant. Varieties treatment produced the highest number of filled pods in variety of Dena (42.9), while the treatment of seeds was produced by the Marshal treatment (45.4). There was interaction between soybean varieties and seed treatment. Untreated soybean plants produced a number of filled pods that did not differ from those of the seed treated plants. Cruiser treatment on the Devon variety actually reduced the number of filled pods per plants. The highest value of filled pods per plant was produced by combination of Devon variety with Marshal treatment (51.5), and the lowest value resulted from the combination of Devon variety with Cruiser treatment (24.4).

Table 4. Number of pods per plant on two varieties of soybean using seed treatment in Village of Nggembe, District of Bolo, Bima Regency 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 24.4 c      | 51.5 a      | 34.0 bc     | 44.1 ab     | 38.5    |
| Dena      | 49.7 a      | 39.3 ab     | 42.8 ab     | 39.6 ab     | 42.9    |
| Average   | 37.1        | 45.4        | 38.4        | 41.4        |         |

*Information: same letters given in the columns and rows shows no real different based on DMRT α= 0.05*

The result obtained were in line with [12] on the Rhizobium application, which showed that Rhizobium treatment together with manure and PK chemical fertilizer into soybean plants on ultisol soil resulted in the number of filled pods per plant that was not different from control. Meanwhile in rice, [4] showed that insecticide treatment on the seeds of several rice varieties had a significant effect on the number of grains per panicle and number of filled grains per panicle.

3.2.2. Weight of 100 seeds. Soybean varieties and seeds treatment had no significant effect on the weight of 100 seeds. Based on soybean varieties, the weight of 100 seeds of Devon and Dena was not much different (15.4 and 15.7). Meanwhile, based on seeds treatment, Marshal produced the highest value (16.2 gram) (Table 5). There was interaction between soybean varieties and seeds treatment with different value found in the combination of Devon-Marshall (16.9) with Devon-Cruiser (13.8) and Dena-Control (14.4). Application of the Cruiser to the seeds of Devon variety led to a reduction in the size of soybean seed. On the other hand, the application of Cruiser to Dena variety gave a better response when compared to Devon variety.

Table 5. Weight of 100 seeds for on two soybean varieties using seed treatment in the Village of Nggembe, District of Bolo, Regency of Bima, 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 13.8 c      | 16.9 a      | 15.3 abc    | 16.4 a      | 15.6    |
| Dena      | 16.9 a      | 15.4 abc    | 15.9 ab     | 14.4 bc     | 15.7    |
| Average   | 15.3        | 16.2        | 15.6        | 15.4        |         |

*Information: same letters given in the columns and rows shows no real different based on DMRT α= 0.05*

The weight of 100 soybean seeds determined by genetic factor because there were correlations between ability of plants to adapt to the environment in which they were grown[13]. Each soybean variety had a different seed size because it was influenced by genetic factors related to the assimilate translocation process during seed filling [14].
3.2.3. Plants population. Plants population was only affected by soybean varieties treatment, meanwhile seeds treatment had no significant effect. Based on a single variety factor, Devon produced the largest population (108.8) when compared to Dena variety (84.1) (Table 6). Whereas, the largest plant population based on seeds treatment was produced by the control (106.8). Soybean varieties and seeds treatments had interactions on the total population of soybean plants. The best results were produced by Devon-Control combination (128) but not significantly different from the Devon-Agrisoy combination (112.3).

Table 6. Plant population on two soybean varieties using seeds treatment in Village of Nggembe, District of Bolo, Regency of Bima in 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 95.0 bc     | 100.0 bc    | 112.3 a     | 128.0 a     | 108.8   |
| Dena      | 91.7 bc     | 90.0 bcd    | 69.0 d      | 85.7 cd     | 84.1    |
| Average   | 93.3        | 95.0        | 90.7        | 106.81      |         |

Information: same letters given in the columns and rows shows no real different based on DMRT $\alpha = 0.05$

Plant population can affect the level of soybean production. [13] showed that planting with grain planting tools reduced the population by 27-33.3 %, while the planting method reduced the population by 6.9%.

3.2.4. Productivity. Soybean varieties and seeds treatments had a significant effect on soybean productivity. Based on a single variety factor, Devon had better productivity (2.08 t/ha) than Dena (1.34 t/ha) (Table 7). Meanwhile, the single factor of seed treatment showed that soybean without seeds treatment gave the highest yield (1.90 t/ha) and was different from Agrisoy treatment (1.45 ton/ha) which produced the lowest yield potential. In addition, the factors of varieties and seed treatment had interaction. The best yield was obtained by combination of Devon variety without seeds treatment (2.67 t/ha) and it was different from other combinations.

Table 7. Productivity (t/ha) of two varieties of soybean using seeds treatment in the Village of Nggembe, District of Bolo, Regency of Bima 2019.

| Treatment | Cruiser (A) | Marshal (B) | Agrisoy (C) | Control (D) | Average |
|-----------|-------------|-------------|-------------|-------------|---------|
| Devon     | 1.67 bc     | 2.06 b      | 1.97 bc     | 2.67 a      | 2.08 a  |
| Dena      | 1.70 bc     | 1.53 cd     | 0.93 e      | 1.13 de     | 1.34 b  |
| Average   | 1.70 ab     | 1.79 ab     | 1.45 b      | 1.90 a      |         |

Information: same letters given in the columns and rows shows no real different based on DMRT $\alpha = 0.05$

The effectiveness of seeds treatment using biological agents depended on the type of inoculant, dosage, technic of intake and adhesive material used [3]. [6] showed that coating soybean seeds with *Rhizobium* sp. and *Azotobacter* sp. did not increase yield components and seeds yield. The differences in yield between varieties was assumed due to differences in yield. Based on description of [7], Devon 1 and Dena 1 varieties had a potential yield of 3.09 t/ha and 2.9 t/ha respectively.

Based on results above, it could be seen that seeds treatment with insecticide or even biological agent was not effective in increasing soybean productivity. Based on [3], thiamethoxam had a positive effect in protecting soybeans from attack by seed flies but it was not consistent with soybean yields. In general, seeds treatment did not affect soybean growth and yield, except for Cruiser that affected plants height.
4. Conclusion

Soybean varieties treatment had a significant effect on the plants height and productivity with the best responses produced by variety of Devon 1. Seeds treatment had a significant effect on the plant height and productivity. The highest plant height value was produced by Cruisers treatment, while the highest productivity resulted by soybean without seeds treatment.

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