Study of "Turiman Jale 2-7" system production in acid dry agroecosystem in Lampung Region

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Abstract. Acid dry land is characterized as suboptimal land with low productivity. The "Turiman Jale 2-7" corn-soybean intercropping technology innovation has the potential to provide additional yields on acid dry land. The purpose of this study was to examine the yields of corn and soybeans grown using the "Turiman Jale 2-7" system on acid dry land. The assessment was carried out at the Tegineneng Experimental Garden, Mandah Village, Natar District, South Lampung Regency, Lampung Province. Methods with demonstration plots in the field of 0.75 ha, with 2 treatments using corn and soybean varieties. The research period was January to June 2020. The soybean varieties planted were Dega, Dena, Detam, Detap, Devon, and local Tanggamus. Corn varieties planted were Balitbangtan JH-37 and existing hybrid corn (Bisi-18, DK-771, NK-22, P-27). The corn-soybean intercropping system used a pattern of alternating 2 rows of corn and 7 rows of soybeans. Corn crop rows used a zigzag cropping pattern. The data observed were components of plant vegetative and generative growth. Data analysis using factorial analysis of variance. The results showed the "Turiman Jale 2-7" system produced an average corn productivity of 14,110 kg/ha and an average soybean productivity of 2,370 kg/ha. The "Turiman Jale 2-7" system is able to optimize the productivity of acid dry land which relies on rainwater. The innovation "Turiman Jale 2-7" contributed to increasing the Cropping Index (CI) from CI = 100 to CI = 150-200.

1. Introduction
Acid dry land is characterized as suboptimal land with low productivity. Soil acidity tends to be low (pH <5), poor in organic matter, soil fertility decreases rapidly, and water availability depends on rainfall [1]. This condition becomes a limitation on plant growth.

Dry land in Indonesia is around 52.83 million hectares which has the potential for food crops, but only 5.1 million hectares have been utilized. The potential for dry land in Lampung is quite extensive (around 2.7 million ha) and is used for food crops covering an area of 912,609 ha [2,3]. Acid soils in the Lampung region are classified as inceptisols, oxisols and ultisols. According to Mulyani et al. [4], It had been identified as much as 1.1 million ha of inceptisols, 1 million ha of oxisols and 0.5 million ha of ultisols. So that dry land is very potential as food buffer land according to the agroecological zone [5].

However, farming on acid dry land needs a technological breakthrough [6,7]. Upland rice cultivation can be carried out at a slope below 15% and requires adequate conservation [8]. Efforts to restore soil fertility are relatively necessary by utilizing agricultural waste such as straw waste around 10 ton ha⁻¹ or equivalent to 4 – 6 ton of compost per hectare per season [9,10,11]. On acid dry land, it is very important to manage irrigation water for the production process [12,13,14].
Corn and soybeans are alternative food commodities after rice. Corn and soybeans are used as raw materials for food and the livestock feed industry. The fulfillment of these two commodities came from domestic production and imports [15,16]. The average national corn import is around 4% of demand while soybean imports are 80% [17,18]. Corn production in Lampung in 2019 reached 2,374,384 tons. The area for planting corn is 426,972 ha, so that the corn productivity is around 5,561 kg ha\(^{-1}\). Soybean production in 2019 reached 12,318 tons planted on an area of 9,334 ha, so that soybean productivity averaged 1,320 kg ha\(^{-1}\) [19]. However, the demand for corn tends to increase every year. So that the demand for corn production every year also tends to increase.

The government is trying to maintain sufficient supplies of corn and soybeans. One of the programs is to spur domestic corn and soybean production through intensification and extensification efforts [20]. Corn and soybean crops can be planted on acid dry land. The intercropping system with a technological innovation component in it is very potential to be applied for the purpose of increasing the cropping index on acid dry land. Technological innovation to increase the cropping index are regulating water, cropping patterns, planting schedules [21,22,23].

Plant cultivation technology innovations by combining corn and soybeans have been produced by research institutes. The point is to encourage an increase in the cropping index, production and farmer income. Corn, soybean, and rice commodities can be planted with intercropping technology innovation [24,25]. The productivity of rice and legume intercropping is higher than the monoculture cropping system [26,27]. Intercropping of cassava with upland rice, corn, soybeans, peanuts is very prospective [28]. Even though this planting system requires cash costs in producing corn [29], it is still feasible and profitable [30].

The technology innovation of intercropping (turiman) system by planting soybeans together with other commodities such as corn on dry land is very prospective to be implemented. Corn and soybeans have a complementary effect by modifying the number of specific rows. The technology innovation for corn-soybean intercropping or “Turiman Jale 2-7” has the potential to provide additional yields on acid dry land. The purpose of this study was to examine the yields of corn and soybean grown using the “Turiman Jale 2-7” system on acid dry land in the Lampung region.

2. Methods
The study was conducted at Tegineneng Experimental Garden, Natar District, South Lampung Regency, Lampung Province. The type of land agroecosystem is acid dry land, which has pH KCl of 4.75 and pH H\(_2\)O of 5.53 from the current soil analysis. The research period was January to June 2020. The method used was a demonstration plot in a 0.75 ha field, with 2 treatments, the corn varieties and soybean varieties using “Turiman Jale 2-7”. The technological innovation “Turiman Jale 2-7” is an intercropping system by planting 2 rows of corn and 7 alternating rows of soybean plants. Corn rows used zigzag cropping pattern. The tools and supporting materials used in the field include: corn seeds, soybean seeds, agricultural production facilities, name planks, wood, bamboo, tape, rope, sickle, and others.

Figure 1 describes the plant varieties combination layout. Corn was planted in 2 rows in zig zag cropping pattern with spacing of (70 + 12.5) cm x 20 cm that looked like 4 rows planted with 1 seed per hole. Corn varieties in layout are J1 = JH-37, J2 = NK-22, J3 = Pioneer-27, J4 = DK-771, and J5 = Bisi-18. And soybean was planted in 7 rows with spacing of 35 cm x 20 cm and planted with 1-2 seeds per hole. Soybean varieties in layout are K1 = Dega-1, K2 = Detam, K3 = Dena, K4 = Dekap, K5 = Devon, and K6 = local. The spacing between corn and soybean was 35 cm. The corn population was around 65-70 thousand ha\(^{-1}\) and soybean population was around 300 thousand plants ha\(^{-1}\).
Soybeans were planted 3 weeks earlier than corn. Biodecomposer was used as much as 2 lt ha\(^{-1}\) (M-\text{Dec}, Petrofast, EM-4, etc.). Corn seed treatment was using metalaxyl or dimetomorph 200 g \(1\) ha\(^{-1}\) and soybean seed treatment was using Agrisoy 40 gr per 8 kg of seeds or Rhizobium 50 g per 5 liter of water. The use of biological fertilizers was 15-30 kg ha\(^{-1}\) (Kayabio/Agrimeth/Agriceplus/Petroganic, etc.). The use of organic fertilizer/compost was 2 ton ha\(^{-1}\). The use of artificial fertilizers were NPK Phonska for corn 450 kg ha\(^{-1}\) and for soybean 120 kg ha\(^{-1}\). The use of urea for corn was 150 kg ha\(^{-1}\), while SP-36 for corn was 150 kg ha\(^{-1}\), while SP-36 for soybean is 90 kg ha\(^{-1}\). And the use of lime/dolomite was 2 ton ha\(^{-1}\) during soil cultivation. The yield was obtained from tile sample measurement method, each treatment was taken 3 times and then averaged. The tile size for the corn was 2.35 m\(^2\) and soybean was 2.45 m\(^2\).

The data observed were plant vegetative variables such as plant height, number of leaves, and generative variables related to production components of corn and soybean. Data analysis was performed with analysis of variance (ANOVA) from split plot design and continued with Duncan test. The data presented using statistical descriptive.

### 3. Results and discussion

#### 3.1. Corn growth in the "Turiman Jale 2-7" corn and soybean intercropping system

The "Turiman Jale 2-7" corn and soybean intercropping system planted on the acid dry land of Tegeneng Experimental Garden, Natar, South Lampung showed optimal growth. The varieties of corn planted were Balitbangtan JH-37 and existing hybrid corn by multinational products (Bisi-18, DK-771, NK-22. P-27). The results of observations on corn growth in the "Turiman Jale 2-7" cropping system showed quite good vegetative growth (table 1).

The vegetative growth variable of plant height between corn varieties showed a significant difference in the Duncan test at 1% level. The highest corn plant height was in the P-27 variety (219.00 cm) and the lowest was in the NK-22 variety (205.83 cm), while the JH-37 variety was only 217.17 cm. The vegetative growth variable of corn in several soybean varieties also showed a significant difference in the Duncan test at 1% level. The highest corn plant height was corn planted with Detam soybean variety (220.40 cm) and the lowest corn planted with local varieties (211.40 cm). There was a very significant interaction between corn and soybeans (\(F = 15.058\)) in the Duncan real difference test at 1% level.
### Table 1. Vegetative and generative corn plant growth with "Turiman Jale 2-7" intercropping system at acid dry land in Tegineneng, South Lampung, Lampung Province, 2020.

| No | Intercropping System | Plant height (cm) | Number of leaves | Corn cob length (cm) | Cobs circumferences (cm) | Lengthwise row number | Circular row number | Number of plants per tile (2.35 m²) | Number of cobs per tile (2.35 m²) |
|----|----------------------|-------------------|------------------|---------------------|-------------------------|----------------------|-------------------|-----------------------------------|----------------------------------|
| A  | Between varieties of corn (C) |                  |                  |                     |                         |                      |                   |                                   |                                  |
| 1  | JH-37                | 217.17<sup>bc</sup> | 12.80<sup>b</sup> | 16.25<sup>a</sup> | 4.68<sup>b</sup>     | 31.96<sup>b</sup>     | 14.45<sup>c</sup> | 28.50<sup>a</sup>                 | 26.50<sup>a</sup>                 |
| 2  | Bisi-18              | 212.67<sup>b</sup> | 13.13<sup>c</sup> | 16.97<sup>a</sup> | 4.51<sup>c</sup>     | 33.61<sup>c</sup>     | 14.92<sup>c</sup> | 34.50<sup>b</sup>                 | 33.17<sup>b</sup>                 |
| 3  | DK-771               | 217.17<sup>bc</sup> | 12.40<sup>ab</sup> | 18.66<sup>b</sup> | 4.54<sup>c</sup>     | 36.30<sup>d</sup>     | 12.50<sup>c</sup> | 29.17<sup>a</sup>                 | 29.17<sup>a</sup>                 |
| 4  | NK-22                | 205.83<sup>a</sup> | 12.07<sup>c</sup> | 16.08<sup>a</sup> | 4.52<sup>c</sup>     | 29.68<sup>a</sup>     | 13.83<sup>b</sup> | 34.83<sup>b</sup>                 | 31.33<sup>b</sup>                 |
| 5  | P-27                 | 219.00<sup>c</sup> | 12.80<sup>b</sup> | 15.80<sup>a</sup> | 4.74<sup>b</sup>     | 33.92<sup>c</sup>     | 15.78<sup>c</sup> | 32.83<sup>b</sup>                 | 30.67<sup>b</sup>                 |
|    | Average              | 214.37            | 126.40           | 16.55               | 4.60<sup>c</sup>     | 33.09<sup>c</sup>     | 14.31<sup>c</sup> | 31.97<sup>c</sup>                 | 30.17<sup>c</sup>                 |
| B  | Corn in soybean varieties (S) |                  |                  |                     |                         |                      |                   |                                   |                                  |
| 1  | Dega                 | 212.00<sup>a</sup> | 13.28<sup>b</sup> | 17.21<sup>c</sup> | 4.68<sup>b</sup>     | 30.07<sup>b</sup>     | 14.5<sup>a</sup>   | 32.20<sup>a</sup>                 | 30.80<sup>a</sup>                 |
| 2  | Dena                 | 217.60<sup>bc</sup> | 12.36<sup>c</sup> | 16.53<sup>b</sup> | 4.63<sup>b</sup>     | 33.11<sup>b</sup>     | 14.62<sup>b</sup> | 32.80<sup>a</sup>                 | 30.00<sup>a</sup>                 |
| 3  | Detam                | 220.40<sup>c</sup> | 12.76<sup>ab</sup> | 16.43<sup>ab</sup> | 4.56<sup>c</sup>     | 33.37<sup>b</sup>     | 14.23<sup>b</sup> | 32.00<sup>b</sup>                 | 30.20<sup>b</sup>                 |
| 4  | Detap                | 212.00<sup>a</sup> | 12.80<sup>ab</sup> | 15.96<sup>c</sup> | 4.52<sup>c</sup>     | 32.29<sup>a</sup>     | 14.13<sup>a</sup> | 32.60<sup>a</sup>                 | 31.00<sup>a</sup>                 |
| 5  | Devon                | 212.80<sup>b</sup> | 12.36<sup>c</sup> | 16.73<sup>bc</sup> | 4.57<sup>c</sup>     | 33.04<sup>b</sup>     | 14.11<sup>b</sup> | 32.20<sup>a</sup>                 | 31.20<sup>a</sup>                 |
| 6  | Lokal                | 211.40<sup>a</sup> | 12.28<sup>c</sup> | 16.47<sup>ab</sup> | 4.62<sup>c</sup>     | 32.80<sup>b</sup>     | 14.44<sup>b</sup> | 30.00<sup>b</sup>                 | 27.80<sup>b</sup>                 |
|    | Average              | 214.37            | 12.64            | 16.55               | 4.60<sup>c</sup>     | 32.45<sup>c</sup>     | 14.31<sup>c</sup> | 31.97<sup>c</sup>                 | 30.17<sup>c</sup>                 |
| C  | Corn                  | 11.46<sup>***</sup> | 6.52<sup>**</sup> | 46.00<sup>**</sup> | 8.13<sup>**</sup>   | 34.91<sup>**</sup>   | 36.56<sup>**</sup> | 2.90<sup>**</sup>                 | 2.50<sup>**</sup>                 |
| Soybean               | 4.69<sup>**</sup>   | 4.69<sup>**</sup>  | 4.59<sup>**</sup> | 2.01<sup>ab</sup>  | 1.64<sup>**</sup>   | 0.840<sup>**</sup>  | 0.19<sup>**</sup>                 | 0.38<sup>**</sup>                 |
| Interaction            | 15.06<sup>**</sup>  | 3.05<sup>**</sup>  | 7.35<sup>**</sup> | 1.73<sup>**</sup>  | 9.83<sup>**</sup>   | 3.12<sup>**</sup>   |                                  |                                  |

Source: field observation data, 2020.

Note: The numbers followed by the same letter in one column (in A or B) show no significant difference in the Duncan test at the 5% level.

The vegetative growth variable of corn leaves number between varieties of corn plants showed a significant difference in the Duncan test at 1%. NK-22 (12.07 strands), while JH-37 variety was only 12.80. In the variable number of corn leaves in several soybean varieties also showed a significant difference in the Duncan test at 1% level. The highest number of corn leaves was corn planted with Dega soybean varieties (13.28) and the least corn leaves planted with local varieties of soybeans (12.28).

There is an interaction between corn and soybeans on the variable number of corn leaves that is very significant (F = 3.047) in the Duncan significant difference test at 1% level.

The variables of corn cobs length, circumference, lengthwise rows, circular rows, number of plants per tile, and number of cobs per tile between varieties of corn plants showed significant differences in the Duncan test at 1% level. Likewise, those variables of corn cob length in several soybean varieties also showed significant differences in the Duncan test at 1% level. There was a very significant interaction between corn and soybeans on the variable of corn cobs length (F = 7.355), the number of lengthwise rows (F = 9.826), and the number of circular rows (F = 3.121) in the Duncan significant difference test at 1% level. There was a significant interaction between corn and soybeans on the corn cobs circumference variable (F = 1.727) in the Duncan significant difference test at 5% level. The complete results can be seen in table 1 above.

#### 3.2. Corn yield in the "Turiman Jale 2-7" corn and soybean intercropping system

The parameters of corn yield indicate that the weight of corn cobs between varieties shows a significant difference in the Duncan test at the 1% level. The highest weight of corn cobs was in the DK-771 variety (204.09 g) and the lowest was in the NK-22 variety (179.78 g) while the JH-37 variety was only 180.27 g. The weight variable of corn cobs planted in several soybean varieties also showed a significant
difference in the Duncan test at 1% level. The highest weight of corn cobs was corn planted with Dega soybean variety (206.34 g) and the lowest weight of corn cobs planted with Detap soybean variety (169.89 g). There was a very real interaction in the Duncan significant difference test at 1% level between corn and soybeans on the weight variable of corn cobs (F = 4.969).

The wet weight of shelled per corn cob between varieties showed a significant difference in the Duncan test at 1% level. The highest wet weight of shelled per corn cob was in the DK-771 variety (161.28 g) and the lowest was in the NK-22 variety (143.02 g), while the JH-37 variety was only 146.26 g. The variable of wet weight per corn cobs planted in several soybean varieties also showed a significant difference in the Duncan test at the 1% level. The highest wet weight of shelled per cobs of corn was corn planted with the Dega soybean variety (164.82 g) and the lowest shelled wet weight per corn cobs planted with Detap soybean variety (137.56 g). There was a very real interaction in the Duncan test of 1% difference between corn and soybeans on the variable wet weight per corn cobs (F = 6.283).

The dry weight of shelled per corn cobs between varieties showed a significant difference in the Duncan test at 1% level. The highest dry weight per corn shelled was DK-771 (135.87 g) and the lowest was NK-22 (118.66 g), while the JH-37 variety was 121.60 g. In the variable dry weight of shelled per corn cobs grown in several soybean varieties also showed a significant difference in the Duncan test at 1% level. The highest dry weight per corn cobs was corn planted with Dega soybean variety (138.81 g) and the lowest shelled dry weight per corn cobs planted with Detap soybean variety (115.82 g). There was a very real interaction in the Duncan test of 1% difference between corn and soybeans in the wet weight variable per corn cob (F = 6.474).

The parameters of the weight of 100 seed corn between varieties showed a significant difference in the Duncan test at 1% level. The highest weight of 100 seed corn was DK-771 (37.16 g) and the lowest was P-27 (29.06 g), while JH-37 was 33.17 g. In the weight variable of 100 seed corn planted in several varieties of soybeans also showed a significant difference in the Duncan test at 5% level. The highest weight of 100 seed corn was corn planted with Dega soybean variety (35.12 g) and the lowest weight 100 seed corn planted with Detap soybean variety (32.65 g). There was a very real interaction in the Duncan test of significant difference at 1% level between corn and soybeans on the weight variable of 100 seed corn (F = 2.970).

The parameters of the weight of corn cobs per tile between varieties showed no significant difference in the Duncan test at the 5% level. The highest weight of corn cobs per tile was in DK-771 variety (4,748.50 g) and the lowest was in JH-37 variety (3,701.67 g). In the weight variable of per tile of corn cobs planted in several soybean varieties also did not show a significant difference in the Duncan test at 5% level. The highest weight of corn cobs per tile was corn planted with the Dega soybean variety (5,057 g) and the lowest was corn planted with local varieties of soybean (4,136 g). There was no significant interaction in the Duncan significant difference test at 1% level between corn and soybeans on the weight variable of corn cobs per tile.

Yield of corn cobs per hectare, weight of shelled corn per tile, and yield of shelled corn per hectare between varieties showed no significant difference in the Duncan test at 5%. Likewise, Yield of corn cobs per hectare, weight of shelled corn per tile, and yield of shelled corn per hectare of corn planted in several soybean varieties also did not show a significant difference in the Duncan test at 5% level. However, the highest production of shelled corn was in the Bisi-18 variety of 15,250 kg per hectare. The lowest corn production was the JH-37 variety with 11,724 kg per hectare. Yield of shelled corn per hectare planted in several varieties of soybean showed that the highest was corn planted with Dega soybean varieties (15,995 kg per hectare) and the lowest was corn planted with local varieties of soybeans (12,766 kg per hectare).

This condition was possible because corn and soybeans are grown in optimal conditions of population. So that there is no competition between the two types of plants, but they provide complementary effects. This was consistent with the research of Dewi, Soelistyono and Suryanto [31] that the intercropping treatment of corn with other plants tends to have higher yields. While Sundari’s research [28] stated that intercropping corn, soybeans, peanuts is very potential and prospective because the results are multiple.
Table 2. Corn yield with “Turiman Jale 2-7” intercropping system at acid dry land in Tegineneng, South Lampung, Lampung Province, 2020.

| No | Intercropping System | Cob weight (g) | Wet shelled corn weight per cob (g) | Dry shelled corn weight per cob (g) | 100-seed weight (g) | Cob weight per tile (g) | Corn cobs yield (kg) | Shelled corn weight per tile (g) | Shelled corn yield (kg) |
|----|----------------------|----------------|-----------------------------------|-----------------------------------|---------------------|------------------------|----------------------|------------------------|------------------------|
| A. | Between varieties of corn (C) | | | | | | | | |
| 1. | JH-37 | 180.27a | 146.26a | 121.60ab | 33.17c | 3,701.67a | 15,751.77a | 2,555.18a | 11,724.16a |
| 2. | Bisi-18 | 181.56a | 149.52a | 124.25ab | 31.48b | 4,641.67a | 19,751.77a | 3,583.82a | 15,250.29a |
| 3. | DK-771 | 204.09b | 161.28b | 135.87c | 37.16d | 4,748.50c | 20,206.38d | 3,496.25c | 14,877.66c |
| 4. | NK-22 | 179.78a | 143.02c | 118.66b | 31.12b | 4,632.50c | 19,712.77c | 3,489.75c | 14,850.01c |
| 5. | P-27 | 186.99a | 148.41a | 128.09b | 29.06a | 4,453.33b | 18,950.35a | 3,254.51a | 13,848.97a |
| Average | 186.54 | 149.70 | 125.69 | 33.60 | 4,435.53 | 18,874.61 | 3,315.90 | 14,110.22 | |
| B. | Corn in soybean varieties (S) | | | | | | | | |
| 1. | Dega | 206.34 | 164.82c | 138.81c | 35.12b | 5,057.00b | 21,519.15a | 3,758.96a | 15,995.55a |
| 2. | Dena | 186.94b | 150.74b | 126.27a | 33.06a | 4,517.20a | 19,222.13a | 3,440.00a | 14,638.28a |
| 3. | Detam | 186.44b | 150.05b | 126.02a | 33.69b | 4,450.00b | 18,936.17a | 3,355.63a | 14,279.26a |
| 4. | Detap | 169.89a | 137.56a | 115.82b | 32.65a | 4,272.00b | 18,178.72a | 3,278.89a | 13,952.71a |
| 5. | Devon | 185.48b | 149.04a | 125.73a | 33.84b | 4,181.00b | 17,591.49a | 3,061.71a | 13,028.54a |
| 6. | Lokal | 184.40b | 146.23ab | 121.77ab | 33.17a | 4,136.00b | 17,600.00a | 3,000.24a | 12,766.98a |
| Average | 186.58 | 149.74 | 125.74 | 33.59 | 4,435.53 | 18,874.61 | 3,315.91 | 14,110.22 | |
| C. | Corn | 5.82ab | 4.51ab | 6.08ab | 50.30ab | 1.487ab | 1.487ab | 1.26ab | 1.26ab |
| Soybean | 6.17ab | 6.00ab | 6.41ab | 2.52ab | 0.705ab | 0.705ab | 0.638ab | 0.638ab |
| Interaction C*S | 4.96b | 6.28ab | 6.47ab | 2.970ab | | | | | |

Source: field observation data, 2020.

Moisture content of harvested corn 17-18%. The area of tile is 2.35 m².

The numbers followed by the same letter in one column (at A or B) show no significant difference in the Duncan test at 5% level.

3.3. Growth of soybeans in the "Turiman Jale 2-7" corn and soybean intercropping system

Several soybean varieties was studied in the intercropping system of corn and soybeans "Turiman Jale 2-7" planted on acid dry land, Tegineneng Experimental Garden, Natar, South Lampung. The soybean varieties grown are Dega, Dena, Detam, Devon, Detap, and Local. The results of observations on soybean growth in the "Turiman Jale 2-7" cropping system showed relatively optimum vegetative growth (table 3).

The results of observations on the growth of several soybean varieties which are planted through the intercropping system with various corn plants and the complete results are as shown in table 3 below. The results of analysis of variance showed a significant difference in the 1% Duncan test between soybean varieties on plant height variables. The highest growth occurred in soybean varieties Dena (69.70 cm) and the lowest was soybean varieties Dega (41.84 cm). In the height variable of soybean plants planted intercropping with several varieties of corn showed a significant difference in the Duncan test at 1% level. The highest soybean plant height was the soybean planted with Bisi-18 corn (64.55 cm). The lowest growth of soybean was planted with JH-37 (59.10 cm) corn. There was a very real interaction in the Duncan test of 1% difference between soybeans and corn on the soybean plant height parameter (F = 6.489).

The variable number of soybean branches showed a significant difference in the 5% Duncan test between soybean varieties. The highest number of branches was found in Detam (4.39) and the lowest was in Dega (2.53). In the variable the number of soybean branches planted intercropping with several varieties of corn showed a significant difference in the Duncan test at 1% level. The largest number of soybean branches is soybean planted with DK-771 (4.32) corn. The least number of soybean branches is planted with JH-37 corn (3.54). There was a very real interaction in the Duncan significant difference test at 1% level between soybeans and corn on the parameter of the number of branches of soybean plants (F = 4.448).
The variable of the number of filled pods per soybean plant showed a significant difference in the Duncan test of 5% between cultivated soybean varieties. The highest number of filled pods per plant occurred in the Detam variety (66.11) and the lowest was in the Dega variety (30.05). The variable number of filled pods per soybean plant planted intercropping with several varieties of corn showed a significant difference in the Duncan test at 1% level. The highest number of filled pods per soybean plant is soybean planted with Bisi-18 corn (50.57). The least number of filled pods per soybean plant was planted with JH-37 corn variety (47.31). There was a very real interaction in the Duncan significant difference test at 1% level between soybeans and corn on the parameter of the number of filled pods per soybean plant (F = 3.138).

Table 3. The vegetative and generative of Soybean plant growth with "Turiman Jale 2-7" intercopping system at acid dry land in Tegineneng, South Lampung, Lampung Province, 2020.

| No | Intercropping System | Plant height (cm) | Number of branches | Filled Pod number | Empty pod number | Number of pods | Plant weight (g) |
|----|----------------------|------------------|-------------------|------------------|------------------|---------------|------------------|
| A. | Soybeans in corn varieties (C) |
| 1. | JH-37 | 59.10ab | 3.54a | 47.31a | 2.70ab | 50.01a | 14.12ab |
| 2. | Bisi-18 | 64.55b | 3.75a | 50.57ab | 2.73ab | 53.30ab | 14.17ab |
| 3. | DK-771 | 59.83a | 4.32b | 49.61ab | 2.19a | 51.73a | 12.70a |
| 4. | NK-22 | 60.47a | 3.75a | 48.63a | 2.61ab | 51.24a | 12.95a |
| 5. | P-27 | 63.84b | 3.62a | 55.31a | 3.12a | 58.43b | 15.51b |
| Average | 50.92 | 3.80 | 50.29 | 2.67 | 52.94 | 13.89 |

B. Between varieties of soybean (S)

| 1. | Dega | 41.84a | 2.53a | 30.05a | 2.16ab | 32.13a | 11.58a |
| 2. | Dena | 69.70d | 3.91c | 45.00b | 4.61a | 49.61b | 11.83a |
| 3. | Detam | 63.08c | 4.39b | 66.11d | 1.43a | 67.53d | 14.53bc |
| 4. | Detap | 59.65b | 3.39b | 48.91b | 2.56b | 51.47b | 16.35 |
| 5. | Devon | 69.08d | 4.25c | 54.92b | 2.81b | 57.73c | 15.43bc |
| 6. | Lokal | 65.78c | 4.33a | 56.73c | 2.45b | 59.19c | 13.56a |
| Average | 61.52 | 3.8 | 50.29 | 2.67 | 52.94 | 13.88 |

C. Corn

| 1. | 93.014** | 20.012** | 33.026** | 14.070* | 28.922* | 7.427* |
| 2. | Soybean | 6.599** | 4.279** | 2.460** | 1.656** | 2.600** | 3.056** |
| Interaction C*S | 6.489** | 4.448** | 3.138** | 2.845** | 3.146** | 9.561** |

Source: field observation data, 2020.
Note: The numbers followed by the same letter in one column (in A or B) show no significant difference in the Duncan test at the 5% level.

The variable number of empty pods per soybean plant showed no significant difference in the Duncan test of 5% between cultivated soybean varieties. The highest number of empty pods per plant occurred in soybean varieties Dena (4.61) and the lowest was in soybean varieties Detam (1.43). The variable number of empty pods per soybean plant planted intercropping with several varieties of corn also showed a significant difference in the Duncan test at 1% level. The highest number of empty pods per soybean plant was soybean planted with corn variety P-27 (3.12). The least number of empty pods per soybean plant was planted with DK-771 (2.19) corn. There was a very real interaction in the Duncan significant difference test at 1% level between soybeans and corn on the parameter of the number of empty pods per soybean plant (F = 2.485).

The variables for the total number of pods per soybean plant showed a significant difference in the Duncan test of 5% between cultivated soybean varieties. The highest number of pods per plant occurred in Detam (67.53) and the lowest was in Dega (32.13). The variable of the total number of pods per soybean plant planted intercropping with several varieties of corn also showed a significant difference in the Duncan test at 1% level. The highest number of pods per soybean plant was soybean planted with corn variety P-27 (58.43). The least total number of pods per soybean plant planted with JH-37 corn variety (50.01). There was a very real interaction in the Duncan significant difference test at 1% level between soybeans and corn on the parameter of the total number of pods per soybean plant (F = 3.146).
The wet weight of soybean plant stover shows a significant difference in the 5% Duncan test between cultivated soybean varieties. The highest wet weight of soybean plant stover was found in Detap (16.35 g) and the lowest was in Dega (11.58 g). The wet weight of the soybean crop planted intercropping with several varieties of corn also showed a significant difference in the Duncan test at 1%. The heaviest wet weight of soybean plant stover is soybean grown with corn variety P-27 (15.51 g). The lowest wet weight of soybean plant stover was planted with DK-771 corn (12.70 g). There was a very real interaction in the Duncan test of 1% difference between soybeans and corn in the soybean plant stover wet weight parameter ($F = 9.561$).

From the observations of soybean growth in general, Detam variety showed the best performance in the vegetative phase. Meanwhile, the corn that gave the best growth for soybean was the P-27 variety. 3.4. Soybean yields in the "Turiman Jale 2-7" corn and soybean intercropping system

The soybean production component shows that the number of seeds per soybean plant between varieties shows a significant difference in the Duncan test at 5% level. The highest number of seeds per soybean plant was in the Detam variety (128.95) and the lowest was in the Dega variety (58.56). The variable number of seeds per soybean plant planted in several varieties of corn also showed a significant difference in the Duncan test at 1% level. The highest number of seeds per soybean plant was soybean planted with corn variety P-27 (108.80) and the least number of seeds per soybean plant planted with JH-37 corn variety (92.01). There was a very real interaction in the Duncan significant difference test at 1% level between soybeans and corn on the number of seeds per soybean plant ($F = 3.666$) (Table 4).

The weight of seeds per soybean plant between varieties did not show a significant difference in the Duncan test at 5%. The highest seed weight per soybean plant was Detam variety (15.46 g) and the lowest was local variety (8.77 g). In the variable weight of seeds per soybean plant grown in several varieties of corn also showed a significant difference in the Duncan test at 1% level. The highest seed weight per soybean plant was soybean planted with corn variety P-27 (13.23 g) and the lightest seed weight per soybean plant planted with JH-37 corn variety (11.67 g). There was a very real interaction in the Duncan test of 1% difference between soybeans and corn on the number of seeds per soybean plant ($F = 4.728$).

The number of soybean plants per tile between soybean varieties showed a significant difference in the Duncan test at 5% level. The highest number of soybean plants per tile was Detam (67.80) and the least was local variety (52.60). The variable of the number of soybean plants per tile grown in several varieties of corn did not show a significant difference in the Duncan test at 5% level. The highest number of per tile soybean plants was soybean planted with corn variety Bisi-18 (67.80) and the lowest number of per tile soybean plants planted with JH-37 corn (58.60). There was no very real interaction in the Duncan significant difference test at 5% level between soybeans and corn on the number of soybean plants per tile.

The weight of soybean per tile between soybean varieties showed a significant difference in the Duncan test at 1% level. The highest weight of soybean per tuber was in Devon variety (761.20 g) and the lightest was in Dena variety (400.80 g). In the weight variable per tile of soybean grown in several varieties of corn, it did not show a significant difference in the Duncan test at 5%. The highest weight per tile soybean was grown with corn variety Bisi-18 (691.00 g) and the lowest was planted with DK-771 corn (525.33 g). There was no real interaction in the Duncan significant difference test at 5% level between soybeans and corn on the weight of soybean per tile.

Soybean yield per hectare among soybean varieties shows a significant difference in the Duncan test at 1% level. The highest soybean yield was produced by Devon variety (3,055.5 kg ha$^{-1}$). The lowest soybean yield was Dena variety (1,635.9 kg ha$^{-1}$). For the other four varieties of soybean each gave the following results: Detap (3,055.5 kg ha$^{-1}$), Detam (2,329.8 kg ha$^{-1}$), Local (2,060.4 kg ha$^{-1}$), Dega (2,034.3 kg ha$^{-1}$). The soybean yields grown on several varieties of corn did not show a significant difference in the Duncan test at 5% level. The highest soybean yield was soybean planted with corn variety Bisi-18 (2,820.41 kg ha$^{-1}$) and the lowest soybean yield was soybean grown with corn variety DK-771 (2,144.22 kg ha$^{-1}$).
The results of the intercropping system are in accordance with the research of [32] stated that intercropping corn and soybean yields tangible results. It is also in line with the research of Balitkabi [33] with the intercropping of corn and soybean plants which gives optimal results. The ideal population of corn is 100,000 plants ha\(^{-1}\). While the soybean population is 375,000 plants ha\(^{-1}\) with 3 rows of soybean plants.

**Table 4.** Soybean yield with “Turiman Jale 2-7” intercropping system at acid dry land in Tegineneng, South Lampung, Lampung Province, 2020.

| No | Intercropping System | Number of seed per plant | Weight of seed per plant (g) | Number of soybean per tile | Weight of soybean per tile (g) | Production shelled of soybean (kg ha\(^{-1}\)) |
|----|----------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------------------------------|
| A. Soybeans in corn varieties (C) | | | | | | |
| 1. | JH-37 | 92.01\(^a\) | 11.61\(^a\) | 58.60\(^a\) | 544.33\(^a\) | 2,221.77\(^a\) |
| 2. | Bisi-18 | 99.82\(^ab\) | 12.18\(^ab\) | 67.80\(^a\) | 691.00\(^a\) | 2,820.41\(^a\) |
| 3. | DK-771 | 95.02\(^a\) | 12.54\(^ab\) | 59.60\(^a\) | 525.33\(^a\) | 2,144.22\(^a\) |
| 4. | NK-22 | 96.49\(^a\) | 12.43\(^ab\) | 66.80\(^a\) | 578.33\(^a\) | 2,360.54\(^a\) |
| 5. | P-27 | 108.80\(^b\) | 13.23\(^b\) | 60.60\(^b\) | 564.83\(^b\) | 2,305.44\(^b\) |
| Average | 98.43 | 12.40 | 62.68 | 580.76 | 2,427.04 |
| B. Between varieties of soybean (S) | | | | | | |
| 1. | Dega | 58.56\(^a\) | 11.08\(^b\) | 63.60\(^b\) | 498.40\(^a\) | 2,034.3\(^a\) |
| 2. | Deno | 82.64\(^b\) | 11.32\(^b\) | 67.40\(^b\) | 400.80\(^b\) | 1,635.9\(^b\) |
| 3. | Detam | 128.95\(^e\) | 15.46\(^d\) | 67.80 | 570.80\(^ab\) | 2,329.8\(^d\) |
| 4. | Detap | 98.32\(^c\) | 14.77\(^d\) | 62.80\(^b\) | 748.60\(^b\) | 3,055.5\(^c\) |
| 5. | Devon | 107.09\(^cd\) | 12.98\(^c\) | 67.00\(^b\) | 761.20\(^b\) | 3,106.9\(^c\) |
| 6. | Lokal | 115.01\(^d\) | 8.77\(^a\) | 52.60\(^a\) | 504.80\(^a\) | 2,060.4\(^a\) |
| Average | 98.43 | 12.40 | 62.68 | 580.77 | 2,370.47 |
| C. Corn | | | | | | |
| Soybean | 33.710\(^**\) | 21.184\(^**\) | 1.264\(^**\) | 0.609\(^**\) | 0.609\(^**\) |
| Soybean | 2.691* | 1.386\(^**\) | 3.235\(^**\) | 4.176\(^**\) | 4.176\(^**\) |
| Interaction C*S | 3.666** | 4.728** |

Source: field observation data. 2020.

Note: The numbers followed by the same letter in one column (in A or B) show that the Duncan test is not significantly different at the 5% level. Moisture content of harvested soybean is 10%. The area of the tile is 2.45 m\(^2\).

3.5. **Improvement of the crop index on dry acid land**

Limited irrigation water and water sources are the main constraints on acid dry land. Dry land usually relies on rainfall as a source of irrigation. For this reason, the right strategies are calculating the planting time according to the calendar season and the distribution of rainfall will provide the right annual cropping pattern. The application of "Turiman Jale 2-7" intercropping of corn and soybean technology can increase the cropping index. The cropping index on dry land from CI = 100 can be increased to CI = 150-200. The strategy is by overseeing the right start of the planting season or implementing an intercropping system where the soybeans are planted first before the corn. So that at the end of the rainy season there is still sufficient rainfall for planting commodity crops in the second planting season.

4. **Conclusion**

The intercropping system of corn with soybean "Turiman Jale 2-7" in the dry land of the Lampung region resulted in corn yield of 14.11 kg ha\(^{-1}\) and soybean production of 2.37 kg ha\(^{-1}\). The "Turiman Jale 2-7" system was able to optimize the productivity of acid dry land which relies on rainwater. The innovation of the "Turiman Jale 2-7" system contributes to increasing the cropping index on dry land, from CI = 100 to CI = 150-200. The strategies are anticipating the utilization of rainwater availability,
planting early in the rainy season, and applying a calendar planting appropriately. In the future, to increase corn and soybean production and increase the cropping index on dry land, it is necessary to implement a mass application of technological innovation "Turiman jale 2-7" and replicate the application of the intercropping system on dry land throughout Lampung.

Acknowledgement
Acknowledgement are conveyed to BPTP Lampung, IAARD for the allocation of research costs. Also high appreciation goes to Asropi, STP., M.Sc, Rugito, Widodo, Yuli Setyo Rahayu A.Md., Inti, and Akhmad Fauzi, for all assistance in carrying out field research activities.

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