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**Research Paper**

# Evaluation of plant materials on the control of cowpea weevil (C*allosobruchus maculatus*) in stored cowpea

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***ABSTRACT***
*An experiment was conducted at the Crop Production Laboratory, Kogi State University Anyigba, to determine efficacy of selected botanicals on cowpea weevils (Callosobruchus maculatus F). The trial consisted of sixteen treatments laid out in a Complete Randomized Design (CRD). The treatments were: control, tobacco snuff (5g), moringa leaf powder (5g), neem leaf powder (5g), castor leaf powder (5g), dry chilie pepper powder (5g), and a combination of the treatments: 2.5g tobacco leaf powder + 2.5g castor leaf powder, 2.5g tobacco leaf powder + 2.5g neem leaf powder, 2.5g tobacco leaf powder + 2.5g dry chilie pepper powder, 2.5g tobacco leaf powder + 2.5g moringa leaf powder, 2.5g castor leaf powder + 2.5g neem leaf powder, 2.5g castor leaf powder + 2.5g dry chilie pepper powder, 2.5g castor leaf powder + 2.5g moringa leaf powder, 2.5g dry chilie pepper powder + 2.5g moringa leaf powder, 2.5g dry chilie pepper powder + 2.5g neem leaf powder, 2.5g moringa leaf powder + 2.5g neem leaf powder. Treatments were replicated three times. The Data collected include: number of damaged seeds or seeds with weevil emergent holes, number of eggs laid, numbers of live bruchids and number of dead bruchids. The data collected were subjected to square root transformation before been subjected to analysis of variance (AVONA) and means found to be statistically significant at 5% probability level were separated using Studentized Duncan Multiple Range Test (DMRT). For individual treatments, 77 days after application of the botanicals the highest number of live weevil population was observed in cowpea stored in Moringa leaf powder (27 live weevils) while the lowest live weevil population was observed when the cowpea was stored in ground Pepper (3 live weevils), closely followed by grains treated with Tobacco snuff. For the combined applications mixture of Tobacco snuff + Castor Leaf powder offered the best control on live weevils, followed by mixture of Moringa leaf powder + Neem leaf powder, while the highest number of live weevil observed in combined treatments was in mixture of Castor leaf powder + Moringa leaf powder. While all the botanicals performed better than the control in regulating the number of live weevils, the best control was achieved with the use of ground pepper, followed by mixture of Tobacco snuff + Castor powder, then mixture of Moringa leaf powder + Neem leaf powder.*

***KEY WORDS:*** *Cowpea; botanicals; weevils; tobacco snuff; neem leaves powder; moringa leaves powder; pepper and castor leaf powder.*

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## I. INTRODUCTION

Cowpea (*Vigna unguiculata L. Walp*) is an important grain (food) legume of significant economic importance worldwide. In the dry tropical savannah, it is the most important indigenous legume covering 12.5 million hectares with annual production of about 3.0 million tons the tropics. With about 22 - 26% protein, cowpea constitutes a major source of protein for resource poor rural and urban people (FAO, 2012).

Nigeria is one of the world's largest producer of the crop with an average production of 2.92 million tons followed by Niger with 1.10 million tons (FAO, 2012). However, a large junk of the harvests obtained by the rural poor farmers in Nigeria are lost in storage majorly due to insect attacks. In general, losses due to pests attack or diseases can be as high as 90 percent in cowpea.

The primary insect causing losses to stored cowpeas in West Africa is the cowpea weevil, *Callosobruchus maculatus* with infestation beginning in the field at low level. After the crop is placed in storage, the insect population continues to grow until the cowpea is completely damaged, while *Bruchidius atrolineatus* causes losses primarily around harvest times but does not reproduce in storage (Pruthi and Singh., 1944; Singh, 1977; Hassanali *et al*., 1990).

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Losses in cowpea yield due to pests is reported to occur in all stages of plant growth. Up to 100 per cent of seeds may be infested and damaged in 3 - 4 months of storage; with substantial quantitative and qualitative losses manifested by seed perforation and reductions in weight, market value and germination ability of seeds (Oluwafemi, 2012). Although insecticides for grain preservation are widely available (Yallappa, 2012), they require expensive equipment or training for their use, the insecticides are usually expensive, polluting, and potentially dangerous to users. Consequently, many cowpea growers in Nigeria do not use insecticides.

A single female of *Callosobruchus maculatus* can reproduce herself twenty fold every 3 - 4 weeks. Harvested cowpea grains with a very light infestation will have a heavy infestation within 2 - 3 months (Carlos, 2000).

The increasing serious problems of residue and resistance to pesticides and contamination of the biosphere associated with large-scale use of broad spectrum synthetic pesticides have led to calls for effective biodegradable pesticides with greater selectivity (Yallappa *et al*., 2012); and creating worldwide interest in the development of alternative strategies for storage pest control (Heyde *et al*., 1984; Dayan *et al*., 2009). In developing new and alternate pesticides, Yallappa *et al*. (2012) observed that newer insecticides will have to meet entirely different standards. They must be pest specific, non-phytotoxic, non-toxic to mammals, ecofriendly, less prone to pesticide resistance, relatively less expensive, and locally available (Hermawan, *et* al., 1997). Requirements which had led to re-examination of the century-old practices of protecting stored products using plant-derivatives (Talukder, 2006; Lale, 1992; Sahayaraj, 2008); observing that plant derived materials are more readily biodegradable, less likely to contaminate the environment and may be less toxic to mammals (Yallappa *et al*., 2012).

The overall objective of this study is to assess the insecticidal property of some botanicals usually used by farmers: tobacco, castor leaf, neem leaf, moringa leaf, and dry powdered pepper. Also, the possible combinations of these botanicals for optimum, and effective results. Generally, management of cowpea seed storage pests relies heavily on the use of chemical insecticides. However, most of the small scale farmers have not adopted these new techniques due to financial and technical reasons. Resource-poor farmers in Africa employ a range of traditional methods such as use of ash, sand, dry whole pepper, ground pepper or other botanical extracts. As aromatic plants have both medicinal and aromatic properties (Park, *et al*., 2003) and contain a variety of volatile oils which have insecticidal, anti-feeding and repellent effects on insect pests. The chemical repellency hypothesis states that non-host plant odors repel herbivores by disrupting their ability to locate or feed on the host plant (Yallappa *et al*., 2012).

## II. MATERIALS AND METHODS

**Insect stock**

Adult bruchids were obtained from infested cowpea purchased from the open market in Anyigba and were introduced into undamaged cowpea seeds maintained in large specimen bottles with fine net of cloth covering the open end. One male and three female weevils were introduced into the experimental samples (50g of cowpea each) for infestation, and these where subsequently studied for multiplication and grain damage daily for 77 days.

**Experimental cowpea**

The cowpea seeds were purchased from the open market in Anyigba town sorted into undamaged clean cowpea seeds which were used for the experiment. Each sample contains 500 grains of sorted cowpea which were held in sample bottles cover with perforated clothing material.

**Preparation of insecticidal plant material**

The plant materials used for this experiment are: neem leaf (*Azadirachta indica),* dry pepper (*Capsicum annum*), castor leaf (*Ricinus communis*), Moringa leaf (*Moringa oleifera*) and tobacco leaf (*Nicotiana tabacum*).

All the materials used were gotten from Anyigba town: neem, castor and moringa leaves were harvested from available neem, castor or moringa plants air-dried then ground into powdered form before usage; the tobacco leaf was purchased from local alcohol shop in Anyigba market.

**Experimental procedure and design**

The trial a Complete Randomized Design (CRD) consisted of sixteen treatments: control, tobacco snuff (5g), moringa leaf powder (5g), neem leaf powder (5g), castor leaf powder (5g), dry pepper powder (5g), and a combination of the treatments: 2.5g tobacco snuff + 2.5g castor leaf powder, 2.5g tobacco snuff + 2.5g neem leaf powder, 2.5g tobacco snuff + 2.5g dry pepper powder, 2.5g tobacco snuff + 2.5g moringa leaf powder, 2.5g castor leaf powder + 2.5g neem leaf powder, 2.5g castor leaf powder + 2.5g dry pepper powder, 2.5g castor leaf powder + 2.5g moringa leaf powder, 2.5g dry pepper powder + 2.5g moringa leaf powder, 2.5g dry pepper

powder + 2.5g neem leaf powder, 2.5g moringa leaf powder + 2.5g neem leaf powder. All treatments were replicated three times.

**Data collection and statistical analysis**

Data collected include: number of damaged seeds or seeds with weevil holes, number of eggs laid, numbers of live bruchids and number of dead bruchids. Data obtained were subjected to square root transformation before analysis of variance (AVONA) and means found to be statistically significant at 5% probability level were separated using Studentized Duncan Multiple Range Test (DMRT).

## III. RESULTS AND DISCUSSIONS

For individual treatments, 77 days after application of the botanicals the highest number of live weevil population was observed in cowpea stored in Moringa leaf powder (27 live weevils) while the lowest live weevil population was observed when the cowpea was stored in ground Pepper (3 live weevils), which was closely followed by grains treated with Tobacco snuff, with 9 live weevils; an indication that ground pepper suppressed the most the highest number of live weevils. For all individual treatments, significant differences were observed in their outcome in response to live weevils at 14, 35, 42, 49, 56, 63, 70 and 77 days after produce were treated to the botanicals.

For the combined treatments, mixture of Tobacco snuff + Castor Leaf powder offered the best control on live weevils (5 live weevils) followed by mixture of Moringa leaf powder + Neem leaf powder (7 live weevils), while the highest number of live weevil observed in combined treatments was in mixture of Castor leaf powder + Moringa leaf powder (38 live weevils).

Generally, there was significant influence of the botanicals on live weevils at 14, 21, 28, 35, 42, 49, 56, 63 70 and 77 day after produce treatment with the various botanicals (Table 1) with the control treatment giving the highest number of live weevils (60 live weevils) in stored cowpea at 77 days after storage compared with those treated with botanicals.

While all the botanicals performed better than the control in regulating the number of live weevils, the best control was achieved with the use of ground pepper (3 live weevils 77 days after produce treatment) followed by mixture of Tobacco snuff + Castor powder (5 live weevils), then mixture of Moringa leaf powder + Neem leaf powder (7 live weevils). The reduction in number of live weevils is likely to translate into reduction in weevil damage, as less weevils will be available to feed on the grains, thus ensuring better produce storage.

That the botanicals gave better performance compared with the control, is an indication than the botanicals have preservative abilities (Islam *et al*., 2009; Isman, 2006; Talukder *et al.*, 2004; Talukder *et al.*, 2006; Tiwari *et al*., 1995) and justifies their use by most resource-poor farmers in Nigeria rural communities for produce storage.

Ability of the botanicals to induce reduction in number of weevils is in line with previous observations. Many researchers reported that plant parts, oil, extracts, and powder mixed with grain-reduced insect oviposition, egg hatchability, postembryonic development, and progeny production (Rajasekaran and Kumaraswami, 1985; Saxena *et al*., 1986; Khanam *et* al., 1990; Schmidt, *et al*., 1991; Talukder, 1995; Asawalam and Adesiyan, 2001). Lists of 43 plant species have been reported as reproduction inhibitors against stored product insects (Talukder, 1995). Reports have also indicated that plant derivatives including the essential oils caused mortality of insect eggs [82]. Many ground plant parts, extracts, oils, and vapour also suppress many insects (Ahmed and Koppel, 1987; Rajendran and Sriranjini, 2008; Rajashekar *et al*., 2010).

Previous reports have shown that plant extracts showed deleterious effect on the growth and development of insects and reduced larval pupal and adult weight significantly, lengthened the larval and pupal periods, and reduced pupal recovery and adult eclosion (Khanam *et al*., 1990), while Rajasekaran and Kumaraswami (1985) reported that grains coated with plant extracts completely inhibited the development of insect.

Treatment imposed significantly ($p \leq 0.05$) influenced negatively weevil survival at 21, 28, 35, 42, 49, 56, 63 70 and 77 days after the grains were treated with the botanicals (Table 2). The lowest number of dead weevils (15 dead weevils) was observed in the control treatment, while the highest number of dead weevils were in cowpea stored in ground pepper and those stored in mixture of Castor leaf powder + Neem leaf powder (30 dead weevils). Formulations of the botanicals into various mixtures did not show clear patterns in respect of mixture enhancement of potency when compared with results of individual botanicals on numbers of dead weevils. For most combinations the potency of the formulations as shown by dead weevils actually reduced relative to results of the individual botanicals.

## IV. CONCLUSION

The increasing problems of resistance and pesticide residue coupled with contamination of the biosphere associated with large-scale use of synthetic pesticides have led to calls for biodegradable pesticides. The situation is further compounded by cost of synthetic herbicides and technical-know-how required for herbicide formulation. This experiment employed plant materials: neem leaf (*Azadirachta indica*), dry pepper (*Capsicum annum*), castor leaf (*Ricinus communis*), Moringa leaf (*Moringa oleifera*) and tobacco leaf (*Nicotiana tabacum*) in the storage of cowpea against cowpea weevils. The experiment showed that while applied botanicals did not prevent weevil reproduction entirely, it enhanced weevil death compared with the control. The best result was obtained with ground pepper for the parameters investigated, however within the time limit of the experiment, complete cessation of reproduction activities among the weevils was not achieved.

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**Table 1: Shows the analysis of live weevils**

| Botanicals | Live weevils | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 days | 14 days | 21 days | 28 days | 35 Days | 42 days | 49 days | 56 days | 63 days | 70 days | 77 days |
| *Control* | 4.00 | 6.00 | 8.00 | 9.00 | 15.00 | 23.00 | 21.00 | 40.00 | 45.00 | 53.00 | 60.00 |
| **Single applications** | | | | | | | | | | | |
| *Tobacco snuff powder* | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 | 3.00 | 3.00 | 7.00 | 7.00 | 9.00 | 9.00 |
| *Neem leaf powder* | 6.00 | 5.00 | 1.00 | 1.00 | 2.00 | 6.00 | 11.00 | 12.00 | 14.00 | 18.00 | 24.00 |
| *Moringa leaf powder* | 2.00 | 5.00 | 1.00 | 1.00 | 8.00 | 11.00 | 13.00 | 17.00 | 22.00 | 23.00 | 27.00 |
| *Pepper powder* | 4.00 | 2.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 3.00 |
| *Castor leaf powder* | 4.00 | 1.00 | 1.00 | 1.00 | 8.00 | 9.00 | 11.00 | 11.00 | 13.00 | 17.00 | 18.00 |
| **Combined treatments** | | | | | | | | | | | |
| *Tobacco snuff + Castor powder* | 3.00 | 2.00 | 1.00 | 1.00 | 1.00 | 4.00 | 4.00 | 5.00 | 7.00 | 8.00 | 5.00 |
| *Tobacco snuff + Neem leaf powder* | 1.00 | 4.00 | 2.00 | 7.00 | 4.00 | 5.00 | 6.00 | 12.00 | 17.00 | 18.00 | 18.00 |
| *Tobacco snuff + Pepper powder* | 2.00 | 4.00 | 1.00 | 1.00 | 10.00 | 12.00 | 12.00 | 17.00 | 21.00 | 13.00 | 27.00 |
| *Tobacco snuff + Moringa leaf powder* | 6.00 | 1.00 | 1.00 | 1.00 | 5.00 | 6.00 | 8.00 | 13.00 | 15.00 | 19.00 | 19.00 |
| *Castor leaf powder + Neem leaf powder* | 1.00 | 2.00 | 1.00 | 1.00 | 4.00 | 5.00 | 8.00 | 8.00 | 10.00 | 12.00 | 12.00 |
| *Castor leaf powder + Pepper powder* | 3.00 | 3.00 | 1.00 | 4.00 | 3.00 | 6.00 | 9.00 | 13.00 | 19.00 | 20.00 | 23.00 |
| *Castor leaf powder + Moringa leaf powder* | 5.00 | 5.00 | 1.00 | 1.00 | 2.00 | 15.00 | 20.00 | 24.00 | 29.00 | 34.00 | 38.00 |
| *Castor leaf powder + Moringa leaf powder* | 3.00 | 2.00 | 1.00 | 1.00 | 1.00 | 3.00 | 3.00 | 8.00 | 11.00 | 11.00 | 11.00 |
| *Pepper powder + Neem leaf powder* | 4.00 | 2.00 | 1.00 | 1.00 | 4.00 | 8.00 | 10.00 | 15.00 | 18.00 | 22.00 | 24.00 |
| *Moringa leaf powder + Neem leaf powder* | 2.00 | 2.00 | 1.00 | 1.00 | 1.00 | 3.00 | 3.00 | 4.00 | 5.00 | 7.00 | 7.00 |
| **SE±** | Ns | 0.052 | 0.002 | 0.016 | 1.133 | 1.195 | 1.130 | 2.800 | 2.340 | 3.804 | 1.450 |

**Table 2: Shows the analysis of dead weevils**

| Botanicals | Dead weevils | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 days | 14 days | 21 days | 28 days | 35 days | 42 days | 49 days | 56 days | 63 days | 70 days | 77 days |
| *Control* | 2.00 | 6.00 | 6.00 | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 | 14.00 | 14.00 | 15.00 |
| **Single applications** | | | | | | | | | | | |
| *Tobacco snuff powder* | 3.00 | 8.00 | 13.00 | 19.00 | 21.00 | 21.00 | 23.00 | 23.00 | 27.00 | 27.00 | 27.00 |
| *Neem leaf powder* | 0.00 | 2.00 | 6.00 | 13.00 | 15.00 | 15.00 | 17.00 | 17.00 | 19.00 | 19.00 | 20.00 |
| *Moringa leaf powder* | 2.00 | 5.00 | 9.00 | 16.00 | 17.00 | 17.00 | 19.00 | 19.00 | 19.00 | 19.00 | 21.00 |
| *Pepper powder* | 1.00 | 5.00 | 14.00 | 25.00 | 27.00 | 27.00 | 28.00 | 28.00 | 29.00 | 29.00 | 30.00 |
| *Castor leaf powder* | 1.00 | 6.00 | 12.00 | 20.00 | 23.00 | 23.00 | 25.00 | 25.00 | 26.00 | 26.00 | 27.00 |
| **Combined treatments** | | | | | | | | | | | |
| *Tobacco snuff + Castor powder* | 1.00 | 5.00 | 9.00 | 14.00 | 16.00 | 16.00 | 19.00 | 19.00 | 21.00 | 21.00 | 24.00 |
| *Tobacco snuff + Neem leaf powder* | 1.00 | 3.00 | 5.00 | 10.00 | 12.00 | 12.00 | 15.00 | 15.00 | 16.00 | 16.00 | 19.00 |
| *Tobacco snuff + Pepper powder* | 1.00 | 5.00 | 11.00 | 16.00 | 19.00 | 19.00 | 23.00 | 23.00 | 26.00 | 26.00 | 27.00 |
| *Tobacco snuff + Moringa leaf powder* | 1.00 | 5.00 | 12.00 | 22.00 | 22.00 | 22.00 | 24.00 | 24.00 | 25.00 | 25.00 | 26.00 |
| *Castor leaf powder + Neem leaf powder* | 3.00 | 8.00 | 16.00 | 24.00 | 25.00 | 25.00 | 27.00 | 27.00 | 28.00 | 28.00 | 30.00 |
| *Castor leaf powder + Pepper powder* | 2.00 | 5.00 | 7.00 | 14.00 | 17.00 | 17.00 | 19.00 | 19.00 | 21.00 | 21.00 | 23.00 |
| *Castor leaf powder + Moringa leaf powder* | 1.00 | 4.00 | 8.00 | 14.00 | 16.00 | 16.00 | 18.00 | 18.00 | 21.00 | 21.00 | 22.00 |
| *Castor leaf powder + Moringa leaf powder* | 2.00 | 6.00 | 12.00 | 18.00 | 19.00 | 19.00 | 21.00 | 21.00 | 21.00 | 21.00 | 23.00 |
| *Pepper powder + Neem leaf powder* | 1.00 | 6.00 | 10.00 | 16.00 | 17.00 | 17.00 | 19.00 | 19.00 | 21.00 | 21.00 | 23.00 |
| *Moringa leaf powder + Neem leaf powder* | 2.00 | 6.00 | 9.00 | 16.00 | 17.00 | 17.00 | 19.00 | 19.00 | 21.00 | 21.00 | 23.00 |
| **SE±** | Ns | Ns | 0.791 | 0.583 | 0.269 | 1.851 | 1.262 | 1.262 | 1.237 | 1.237 | 2.117 |

**Table 3: Shows the analysis of damaged Seeds**

| Botanicals | Damaged Seeds (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 days | 14 days | 21 days | 28 days | 35 Days | 42 days | 49 days | 56 days | 63 days | 70 days | 77 days |
| *Control* | 3.00 | 5.00 | 5.00 | 15.00 | 45.00 | 60.00 | 61.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Single applications** | | | | | | | | | | | |
| *Tobacco snuff powder* | 1.00 | 1.00 | 1.00 | 1.00 | 3.00 | 4.00 | 4.00 | 10.00 | 10.00 | 13.00 | 13.00 |
| *Neem leaf powder* | 3.00 | 5.00 | 5.00 | 6.00 | 7.00 | 10.00 | 11.00 | 12.00 | 15.00 | 21.00 | 27.00 |
| *Moringa leaf powder* | 3.00 | 5.00 | 5.00 | 8.00 | 11.00 | 13.00 | 16.00 | 17.00 | 22.00 | 26.00 | 29.00 |
| *Pepper powder* | 1.00 | 2.00 | 3.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 5.00 | 5.00 |
| *Castor leaf powder* | 3.00 | 5.00 | 5.00 | 8.00 | 10.00 | 11.00 | 12.00 | 12.00 | 13.00 | 19.00 | 21.00 |
| **Combined treatments** | | | | | | | | | | | |
| *Tobacco snuff + Castor powder* | 2.00 | 2.00 | 2.00 | 3.00 | 3.00 | 5.00 | 6.00 | 6.00 | 7.00 | 8.00 | 16.10 |
| *Tobacco snuff + Neem leaf powder* | 2.00 | 4.00 | 4.00 | 7.00 | 8.00 | 11.00 | 11.00 | 12.00 | 15.00 | 15.00 | 18.20 |
| *Tobacco snuff + Pepper powder* | 0.00 | 0.00 | 2.00 | 2.00 | 3.00 | 5.00 | 5.00 | 5.00 | 5.00 | 7.00 | 7.30 |
| *Tobacco snuff + Moringa leaf powder* | 2.00 | 3.00 | 3.00 | 4.00 | 6.00 | 8.00 | 9.00 | 11.00 | 15.20 | 17.00 | 25.00 |
| *Castor leaf powder + Neem leaf powder* | 2.00 | 2.00 | 3.00 | 5.00 | 5.00 | 8.00 | 8.45 | 9.20 | 10.00 | 12.30 | 16.25 |
| *Castor leaf powder + Pepper powder* | 3.00 | 3.00 | 1.00 | 4.00 | 6.00 | 8.00 | 9.00 | 11.00 | 15.20 | 17.00 | 25.00 |
| *Castor leaf powder + Moringa leaf powder* | 5.00 | 5.25 | 8.40 | 10.00 | 12.00 | 18.15 | 20.00 | 28.00 | 32.40 | 40.20 | 48.15 |
| *Castor leaf powder + Moringa leaf powder* | 3.00 | 3.25 | 3.25 | 4.50 | 7.00 | 9.10 | 13.00 | 13.00 | 13.00 | 15.00 | 15.25 |
| *Pepper powder + Neem leaf powder* | 3.45 | 4.00 | 4.00 | 4.00 | 5.00 | 10.20 | 15.00 | 18.20 | 20.40 | 22.15 | 27.00 |
| *Moringa leaf powder + Neem leaf powder* | 3.00 | 3.35 | 4.00 | 4.00 | 4.00 | 8.40 | 8.50 | 9.00 | 10.00 | 10.00 | 10.00 |
| **SE±** | **Ns** | **0.021** | **0.001** | **1.002** | **2.016** | **3.587** | **3.910** | **3.712** | **4.120** | **2.654** | **4.364** |