# Rice Straighthead Decreasing and Seed Set Increasing Associated with the Application of Calcium on a Silt Loam soil

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## ABSTRACT

Seed set rate (%) was analyzed using SAS program version 12.0. Analysis of Variance of the seed set rate showed that the variations due to varieties, Ca treatments and their interactions were all highly significant ($p<0.000$). The difference among the varieties showed that the most susceptible cultivar Cocodrie had almost no seed set (1%) for CK (No Ca), while V+B-Ca treatment recovered Cocodrie to 52% seed set rate; the medium resistance varieties 8-18 and 12-38 had seed set rates 9% and 61% for treatment CK (no Ca), respectively, and increased to 62% and 74% under the treatment of V+B_Ca treatment, respectively; the relative high resistant cultivar 8-9 had 78% seed set rate under the treatment of CK (No Ca), and increased to 90% under the treatment of V+B_Ca. Average over all treatments, Cocodrie had seed set rate of 21%, while line 8-9, the mostly resistant, had a seed set of 80%. There were also big differences among the Ca treatments. Over all varieties, CK (no Ca treatment) had the lowest seed set rate of 37%, while the V+B-Ca treatment resulted in the highest average seed set of 70%, which was also significantly higher than the 47% average seed set rate of 4 varieties for V-Ca and B-Ca treatments.

## INTRODUCTIONS

Straighthead disorder is the most widespread non-fungal disease of the U.S. rice and the oldest rice disease in Arkansas, observed since the early 1900s when rice was first grown in Arkansas (Scott and Cartwright, 2002). Yield losses can approach 100% when a highly susceptible variety is planted on a soil with a history of severe straighthead (Yan et al., 2005; Wilson et al., 2010). For example, yield losses of 94% were observed in Cocodrie (Wilson et al., 2001), a long grain cultivar that has played major role in southern rice production since 2000 (Linscombe et al., 2000). The exact cause of straighthead is unknown, although researchers had reported that straighthead increased with the traditional way of flooding (Wells and Gilmour, 1977; Wilson et al., 2001), on sandy to silt loam textured soils (Collier, 1912; Adair et al., 1973), at low soil pH and low free iron (Baba and Harada, 1954), high levels of organic matter in soil (Jones et al., 1938, p. 28), high temperature during the productive stage (Huang et al., 2009), and high arsenic (As) level in the soil (Wells and Gilmour, 1977; Horton et al., 1983; Yan et al., 2005; Yan et al, 2008). Even though large efforts have been made to study straighghtead disease for improving cultivar resistance, its causal factors are still not exactly known. After reviewing the previous studies, we conducted this experiment in greenhouse conditions to evaluate the effects of Ca to straighthead when Ca was added into the soil. This study addressed whether or not there were different responses to Ca treatments among the varieties which were ranked from susceptible, medium resistant and high resistance to straighthead in previous studies.

## MATERIALS AND METHODS

US cultivar Cocodrie and three breeding lines, 8-18, 8-9 and 12-38 were used for this study. Cocodrie is known to be susceptible to straighthead, so has been widely used as susceptible check in studies for straighthead. However, The breedling lines 8-18, 8-9 and 12-38 are relatively resistant to straighthead. Three plants were grown in each pot (22 cm tall and 22 cm diameter) filled up with the silt loam soil collected from University of Arkansas at Pine Bluff farm where the straighthead naturally occurred. Four levels of Ca treatments, 0g Ca, 297g Ca (Calcium carbonate) at vegetative stage (V-Ca), 535g Ca at booting stage (B-Ca), and V-Ca plus B-Ca (VB-Ca), were applied to each of the varieties with three replications. Within each replication, the pots were completely and randomly placed. During the season, a variation of straighthead symptoms including sterile and deformed grains and panicles were observed among the Ca treatments and varieties. At maturity, 5 representative panicles were harvested from each pot to record seed set rate (%) for assessing straighthead, which is very resistant at more than 80% of seed set rate and very susceptible at 0% of seed set rate. Data were analyzed using SAS package.

## PICTURES OF 30 DAYS AFTER GERMINATION

COCODRI (susceptible to straighthead)

Water 300g CaCO3

12-38 (Medium Resistance)

Water 300g CaCO3

8-18 (Medium Resistance)

Water 300g CaCO3

8-9 (Resistance to Straightnead)

Water 300g CaCO3

## PICTURES AT MATURE

Cocodri of No Ca added

Cocodri Ca 300g

## PICTURES AT MATURE

8-18 no Ca Control

8-18 Ca 300g

## PICTURE AT MATURAL FIELD

Cocodri in the natural field without Ca

## Seed Set Rate of Cocodrie (S), 8-18 (M), 12-38 (M), and 8-9 (R) under the Treatment of Ca

| Treatment | Cocodrie (S) | 8-18 (M) | 12-38 (M) | 8-9 (R) | Mean |
|---|---|---|---|---|---|
| CK (No Ca) | 1% | 9% | 61% | 78% | 37% |
| V_Ca | 17% | 48% | 43% | 81% | 47% |
| B_Ca | 13% | 54% | 50% | 70% | 47% |
| V+B_Ca | 52% | 62% | 74% | 90% | 70% |
| Mean | 21% | 43% | 57% | 80% | |

## CONCLUSIONS

- Ca can reduce straight head symptom in a silt loam soil:
- Cocodri is very sensitive to straighthead, but Ca helped in reduce the straighthead symptom.
- 8-9 is resistant to straighthead, so there is no big differences between Ca and No-Ca treatments.
- Further studies will test the effect of Ga in different soil type and the different level of fertilizer.

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