PNA Newsletter 2014/1

Dear reader,

We are pleased to present you the third edition of the PNA Newsletter!

This newsletter covers three topics: the newly created scientific potassium nitrate library, now available on the PNA website, and the benefits of foliar-applied potassium nitrate on crops. The outcomes of two PNA funded research projects in Vietnam and the USA about the positive effects of foliar applied potassium nitrate on rice yield increase and reduced lodging incidence will be presented.

If you want to keep on receiving our PNA Newsletter, please register here (free of charge).

Main topics in this edition

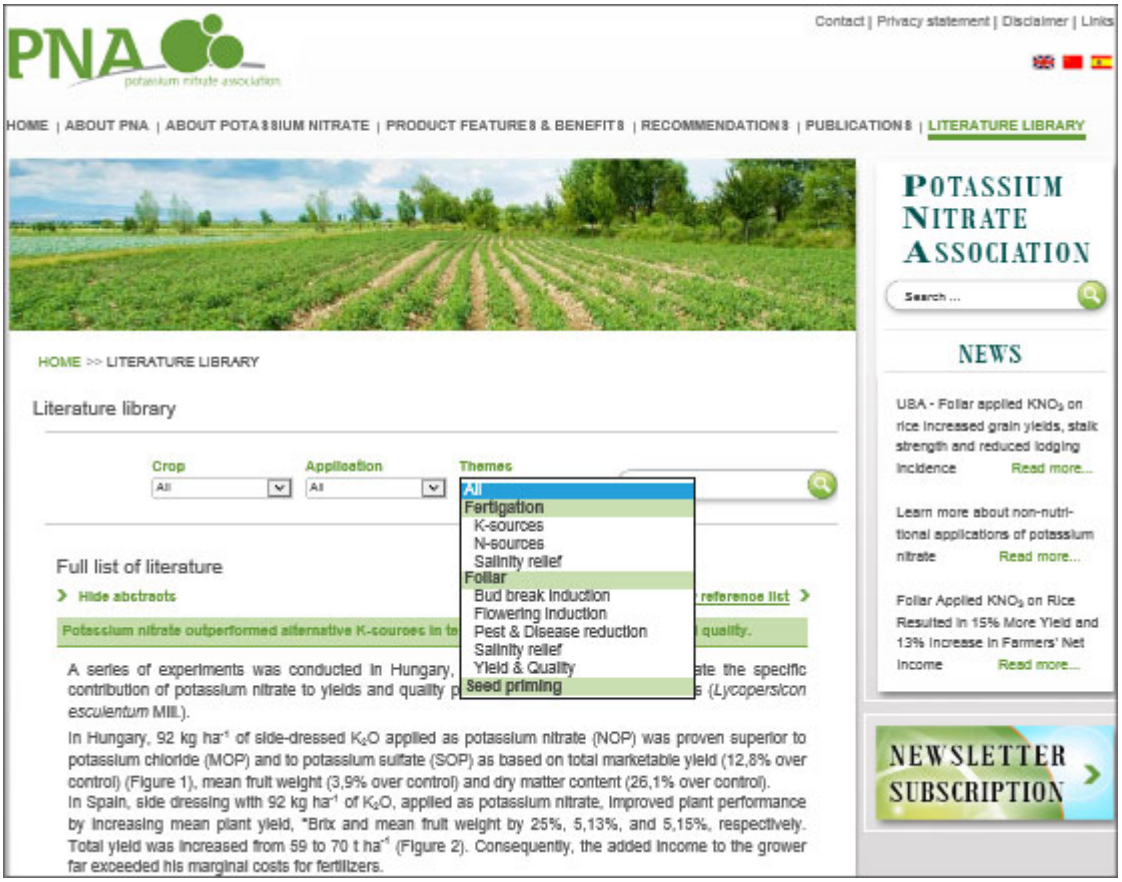
NEW: Scientific Potassium Nitrate Library Now Available on PNA Website

To back up the agronomic use of potassium nitrate with empirical evidence, the PNA website has been enriched with a new tool: the scientific potassium nitrate library! This extension is to be seen as a major step forward in the realization of the PNA's ambition to become and to remain the leading information source about all the agronomic and economic aspects of potassium nitrate.

From each scientific study, previously published in worldwide renowned scientific publications, a summary/abstract has been made which describes the trial set-up and lists the main conclusions and benefits obtained by using potassium nitrate.

The PNA's scientific potassium nitrate library allows:

- To perform a search on scientific literature about potassium nitrate per crop, per application or based on a major topic such as salinity relief. See screenshot below.
- To compose a complete list of header titles by clicking on "Hide abstracts".
- To retrieve a comprehensive literature list by clicking on "Show reference list".
- To search on key words by using the general search tool.



To start with, the website features a basic set of about 50 literature references but in the upcoming months more studies will be uploaded. By continuously uploading new articles, the PNA website will gain more visibility and traffic from search engines. The tool is available in English, and in the next months will be translated into Spanish and Chinese.

To access this library in English surf to: http://www.kno3.org/en/literature-library

Potential Benefits of Foliar-Applied Potassium Nitrate

Introduction

Well-balanced plant nutrition management is essential for maximum yield and quality. Foliar application of plant nutrients is helpful in satisfying plant requirements and can be highly efficient when nutrient uptake via the root system is limited. Foliar application is an attractive remedy especially in arid zones under low rainfall conditions where the lack of water in summer drastically restricts nutrient absorption by plants. Foliar sprays will only show a positive effect on crop yield and/or quality, when nutrient deficiency imbalances will be corrected after such applications. Potassium nitrate sprays can be also used to prevent the occurrence of nutrient deficiency before the first deficiency symptoms appear. This is especially the case when foliar analysis shows lower nutritional levels than the desired optimum levels. Other reasons for potassium nitrate sprays are to increase pest and disease resistance, promote well-balanced fruit and/or plant growth and development, especially in orchards with physiological disorders, and reduce lodging incidence in cereals.

Potassium nitrate sprays should be used only where there is a recognized need. When the plant nutritional status is optimal, no additional effect can be expected from foliar applications.

Situations that make foliar plant nutrition very beneficial

A number of situations can be identified that make foliar plant nutrition very beneficial. The most important ones are listed below, all related to a limited nutrient uptake via the plant's root system:

- Under saline and dry conditions, when root activity is impaired.
- Nutrient deficiency imbalances in the soil (cation competition).
- When nutrient availability for plant uptake is limited:
  - low soil nutrient reserves – as may be the case in sandy, coarse-textured soils, or low soil organic matter content which limits the nutrient holding capacity of the soil.
  - Fixation or immobilization – as may be the case in clay soils, soils with high organic matter content, alkaline soils with high soil pH.
  - Too wet – asphyxia (lack of oxygen).
  - Too cold – limited root activity.
  - When fertilizer applications to the soil are reduced.
  - When nutrient uptake is slowed down, because the root system has been negatively affected by diseases (e.g. nematodes).

- When fertilizer applications to the soil are reduced.
- After flowering, nutrient uptake is slowed down, because of the reduced activity of the root system.

Potential benefits of foliar-applied potassium nitrate

Potential benefits of foliar-applied potassium nitrate can be the following:

- The ability to provide N and K when root activity is impaired.
- Increased production and translocation of carbohydrates from the leaf to the developing seed or fruit.
- Increased fruit retention will reduce early fruit drop, which results in greater yields.
- Improved seed or fruit quality, due to less creasing, splitting and granulation.
- Immediate correction of N and K deficiency imbalances in the plant.
- Increased N use efficiency, because of reduced N losses through denitrification and leaching, compared with soil-applied N fertilizers.
- Reduced disease incidence.
- Reduced lodging incidence in cereals.

Guidelines and recommendations for foliar-applied potassium nitrate

It is suggested to always make a jar test in order to check the compatibility with other ingredients of the tank mix solution in advance and test the foliar spray on a small plot for possible signs of crop damage. Early morning or late afternoon are the best times to spray. Do not apply in full sun conditions in order to reduce the risk of crop burn. Nutrient uptake is enhanced when the pH of the spray tank solution is slightly acidic (pH 4-5).

Visit the following link of our website for crop-specific recommendations for foliar potassium nitrate sprayings, Table 1 for spraying in vegetables, flowers and field crops and Table 2 for sprayings in fruits and nut tree crops: http://kno3.org/en/recommendations/foliar-applications-of-potassium-nitrate.

In the Spotlight: Two PNA Funded Research Projects

To illustrate the benefits of foliar-applied potassium nitrate, the outcomes of two PNA-funded scientific research projects conducted in Vietnam and the USA about the positive effects of foliar-applied potassium nitrate on rice yield increase and reduced lodging incidence are presented.

1. Greater rice grain yield at increased number of foliar potassium nitrate applications.

In 2009, researchers in Vietnam conducted experiments with foliar potassium nitrate (KNO_3: 13% N and 45% K_2O) sprays in paddy rice in North Vietnam to evaluate its effect on yield and yield components, nutrient uptake, as well as agronomic and economic efficiency. Four field experiments were conducted at two locations including: a degraded sandy soil site at Bac Giang Research Station located in Hiep Hoa District, Bac Giang Province (exchangeable K: 31 ppm), and an alluvial clay soil site on the Red River Delta in Xuan Truong District, Nam Dinh Province (exchangeable K: 59 ppm). The degraded soil is prone to leaching of K, and the alluvial soil is associated with K fixation. Both of these soils displayed very low soil exchangeable K contents, making them potentially very responsive to K addition.

Foliar KNO_3 was provided along with combinations of basally applied urea, SSP, KCl, and 8 t/ha of FYM (spring rice only). Foliar applications occurred at one or more different growth stages: Active Tillering (AT), Panicle Initiation (PI), and End of Flowering (F), and each application provided 300 liters of a 3% concentration, equal to 9 kg KNO_3/ha, or 4 kg K_2O/ha and 1.1 kg N/ha. Hills from 4 m² of area centered in each replicated plot were harvested for grain yield determination with 14% moisture. Yield components were determined from 10 hills collected from the sampling zone surrounding the harvest area, as was the procedure for determining dry biomass at the AT, PI, and F stages.

The response to direct FYM application can be quantified in spring rice and was significant ($p = 0.05$) at the degraded soil site at Bac Giang, but not at the alluvial soil site at Nam Dinh (Table 1). In summer rice, check plots showed a significant difference between the basal NP treatment and basal NP plus foliar KNO_3 applied at each of the three growth stages selected. Reliance on basal K alone produced yields that were equal to those resulting from foliar KNO_3 alone at three of the four sites (i.e. excluding the summer rice season at Nam Dinh) where three splits of foliar KNO_3 was superior. Supplementation of the full basal K rate with three foliar KNO_3 applications (T9) produced the highest average yield response across seasons and sites (Table 1). This treatment produced 11% more spring rice and 16% more summer rice on degraded soil; 16% more spring rice and 15% more summer rice on alluvial soil compared to use of basal KCl alone (T3). Single sprays resulted in a more modest yield response of 7% averaged over sites and seasons, while two sprays generated an average yield response of 11% and three sprays an average yield response of 15% (Figure 1). Interestingly, significantly higher yields (10% average response) were also obtained with the combination of three foliar KNO_3 sprays and up to 50% less KCl provided through a base dressing (T10 and T11).

Table 1. Treatments, application stages, applied dose rates and yields for the two trial sites in Vietnam.

Treatment description[1]		Foliar KNO_3 timing[2]			Yield[3] (MT/ha)		
		AT	PI	EF	SS	CS	av.
1a	NP without FYM	0	0	0	4,25	5,61	4,93
1b	NP	0	0	0	5,05	6,80	5,93
2	NP	+	+	+	5,03	6,59	5,81
3	NP (Basal 100% MOP)	0	0	0	5,03	6,13	5,58
4	NP (Basal 100% MOP)	+	0	0	5,34	6,57	5,95
5	NP (Basal 100% MOP)	0	+	0	5,34	6,72	6,03
6	NP (Basal 100% MOP)	0	0	+	5,33	6,62	5,97
7	NP (Basal 100% MOP)	+	+	0	5,50	6,82	6,16
8	NP (Basal 100% MOP)	0	+	+	5,54	6,84	6,19
9	NP (Basal 100% MOP)	+	+	+	5,71	7,08	6,40
10	NP (Basal 75% MOP)	+	+	+	5,63	6,88	6,25
11	NP (Basal 50% MOP)	+	+	+	5,54	6,78	6,16
12	NP (Basal 50% & 50% at PI)	0	0	0	5,26	6,59	5,93
	LSD (P=0,05)				*0,13*	*0,46*	

[1] In spring rice, all treatments received FYM except 1a. In summer rice, no FYM was applied

[2] 0= no foliar K, + = 9 kg KNO_3/ha/application, AT = Active Tillering (20 to 25 DAT), PI = Panicle Initiation (50 to 55 DAT), EF = End of Flowering (25 to 28 days before harvest).

[3] Grain yields are adjusted to 14% moisture, SS=Sandy Soil, CS=Clay Soil, av.=av. both soils

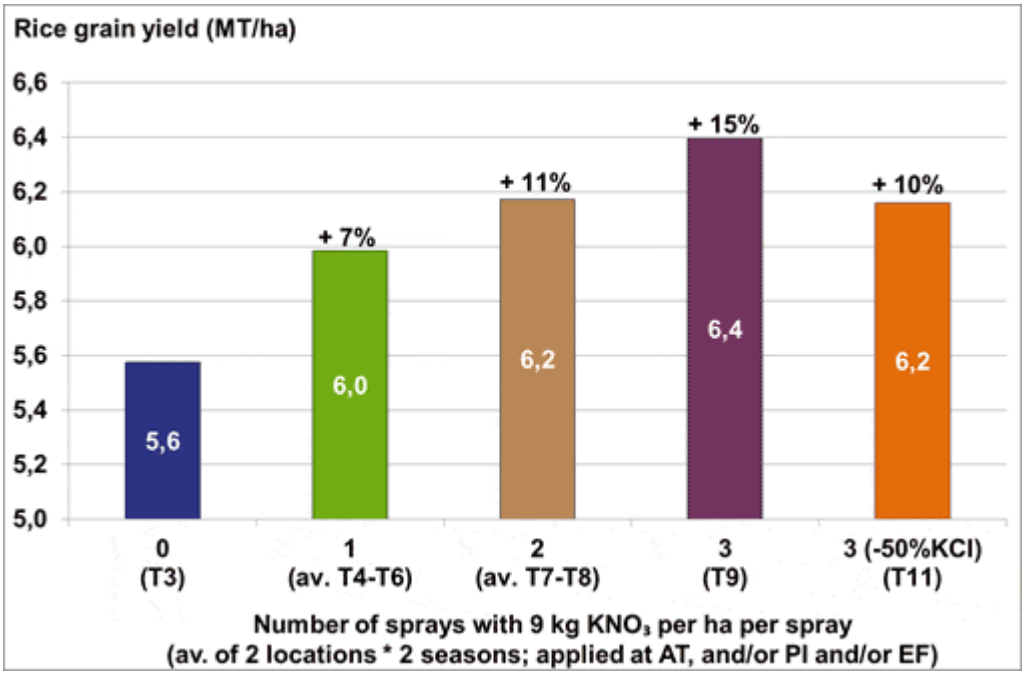


Figure 1. *The effect of number of foliar treatments on the rice grain yield (MT/ha) in two growing seasons spring and summer on two trial sites (AT= active tillering, PI= panicle initiation and EF= end of flowering).*

Economic analysis found a steady increase in net income under single, double, and triple sprayings at both the degraded and alluvial sites (Figure 2). In addition, net income was maintained when basal KCl was decreased by up to 50% in combination with three foliar KNO_3 spray applications, as well as for the treatment that completely substituted basal KCl with three foliar applications of KNO_3 (T2).

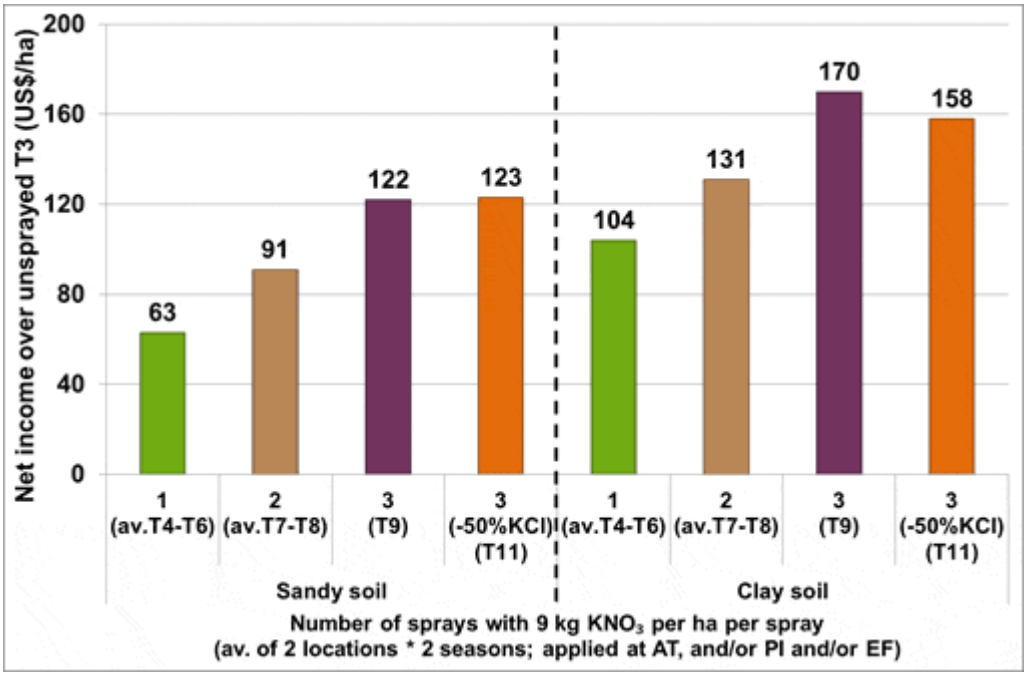


Figure 2. *The positive effect of potassium nitrate sprays on net income (US$/ha) over T3 (100% KCl and no foliar spray).*

Son, T.T., L.X. Anh, Y. Ronen and H.T. Holwerda. 2012. Foliar potassium nitrate application for paddy rice. Better Crops/Vol. 96 (No. 1): 29-31.

2. The effect of foliar-applied potassium nitrate on lodging incidence in rice

Lodging is the phenomenon of grain plants falling over if panicles are too heavy. As a consequence, lodging increases harvesting labour time and costs. Lodging is promoted by heavy winds and rainfall.

Decreased lodging and increased stalk strength are associated with proper K nutrition. Therefore, Dr D. Dunn at the Delta Research Center in Qulin, Missouri (USA) conducted from 2010 to 2012 three years trials with foliar-applied potassium nitrate to study the effect on yield and quality of rice, including the effect on lodging incidence in rice.

The trial consisted of a two-factorial randomized complete bock design with 6 replicates, which resulted in a total of 48 plots. Treatments consisted of 4 doses of KCl, basally-applied at 0%, 50%, 75% and 100% of the soil test based university recommendation for K in combination without or with foliar-applied potassium nitrate, sprayed three times (at pre-flooding, internode elongation and 10% heading), at a dose rate of 11,2 kg potassium nitrate per hectare per spray. The soil type was described as Crowley silt loam soil.

Lodging occurred in two out of three trial years: 2010 and 2012. In both years, potassium nitrate sprays resulted in a statistically significant (P=0,05) reduction in lodging incidence (Figure 3).

In 2010, lodging incidence was reduced from 28% to 21%, due to foliar-applied potassium nitrate. No statistically significant difference was found between the various doses of basally-applied KCl.

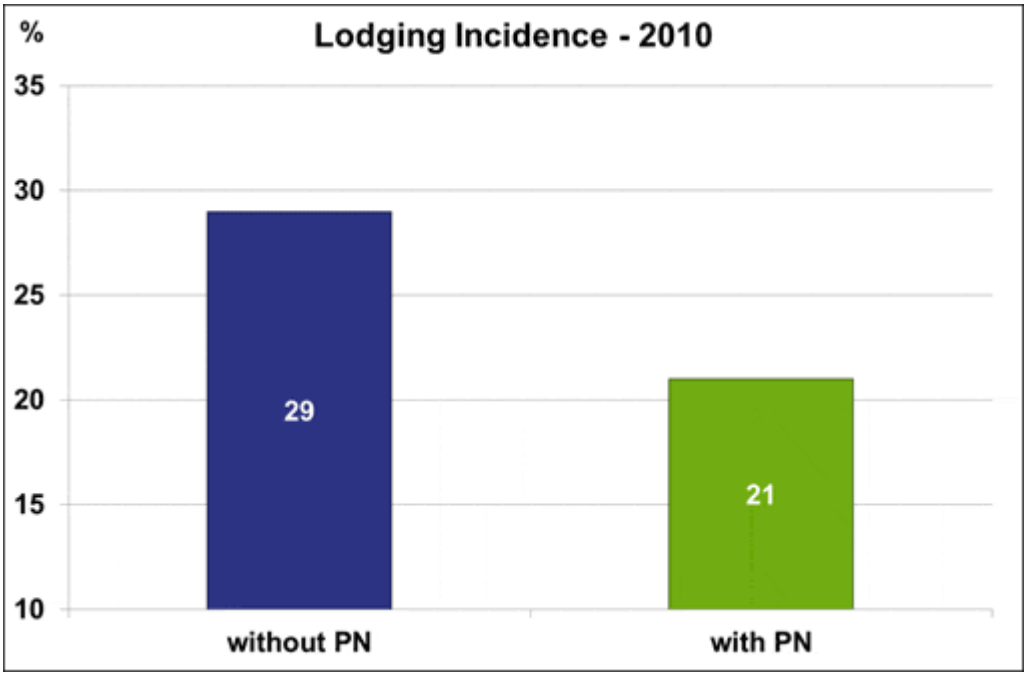


Figure 3. *The effect of foliar-applied potassium nitrate (PN) on lodging incidence in 2010.*

In 2012, a statistically significant interaction (P=0,05) was observed between basally-applied KCl doses and foliar-applied potassium nitrate. Lodging incidence decreased at increasing basally-applied KCl doses and this decrease was further enhanced by the foliar-applied potassium nitrate treatment. The greatest effect of foliar-applied potassium nitrate was found at 0% basally applied KCl dose, which reduced lodging incidence from 60% to 25%. A further gradual decrease in lodging incidence occurred at increasing doses of basally-applied K. Even when 100% of the recommended dose of K was basally-applied, a further decrease in lodging incidence could be achieved with foliar-applied potassium nitrate.

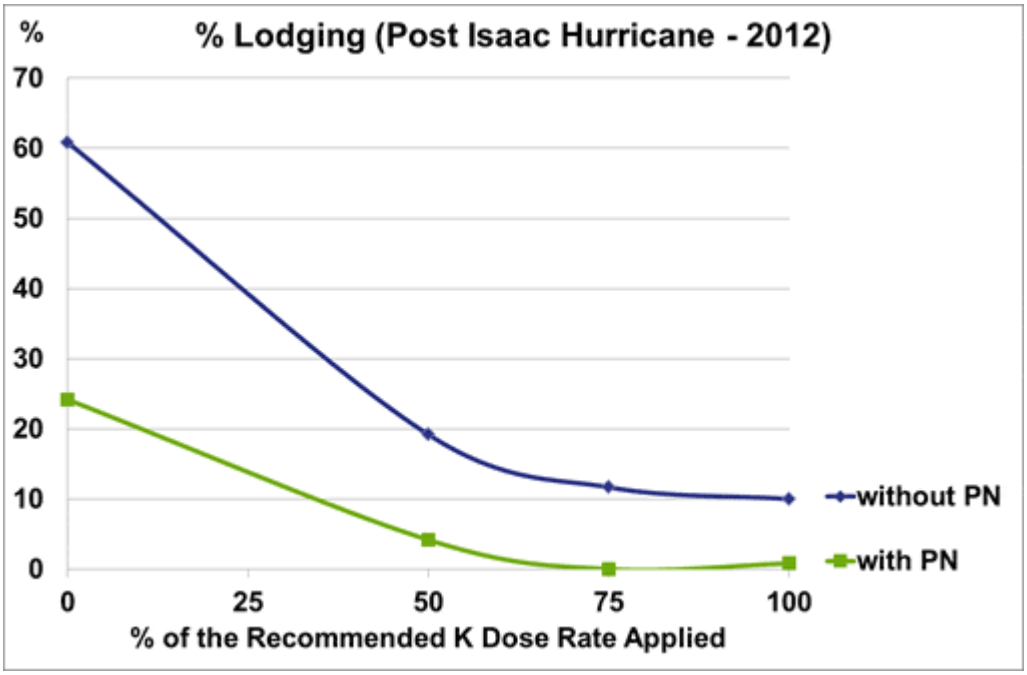


Figure 4. *The effect of the dose rate of basally-applied K as KCl and foliar-applied potassium nitrate (PN) on the lodging incidence in 2012 after hurricane Isaac visited the trial field.*

PNA Contact Details

PNA can be contacted at info@kno3.org.

See for more contact details the PNA website: www.kno3.org.