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Return of Private Foundation or Section 4947(a)(1) Trust Treated as Private Foundation

2016

Department of the Treasury
Internal Revenue Service

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Information about Form 990-PF and its separate instructions is at www.irs.gov/form990pf.

Open to Public Inspection

For calendar year 2016 or tax year beginning

, 2016, and ending

, 20

Name of foundation Nolan Broom Corn Trust		A Employer identification number 59-6566127
Number and street (or P.O. box number if mail is not delivered to street address)	Room/suite	B Telephone number (see instructions) (305) 722-4372
c/o John Swaun, P. O. Box 970103		
City or town, state or province, country, and ZIP or foreign postal code Miami, FL 33197-0103		C If exemption application is pending, check here ☐
G Check all that apply	☐ Initial return ☐ Final return ☐ Address change	☐ Initial return of a former public charity ☐ Amended return ☐ Name change
H Check type of organization. ☐ Section 4947(a)(1) nonexempt charitable trust ☒ Section 501(c)(3) exempt private foundation ☐ Other taxable private foundation		D 1. Foreign organizations, check here ☐ 2. Foreign organizations meeting the 85% test, check here and attach computation ☐
I Fair market value of all assets at end of year (from Part II, col. (c), line 16) \$ 821,454	J Accounting method ☒ Cash ☐ Accrual ☐ Other (specify) _____	E If private foundation status was terminated under section 507(b)(1)(A), check here ☐ F If the foundation is in a 60-month termination under section 507(b)(1)(B), check here ☐

Part I Analysis of Revenue and Expenses (The total of amounts in columns (b), (c), and (d) may not necessarily equal the amounts in column (a) (see instructions))		(a) Revenue and expenses per books	(b) Net investment income	(c) Adjusted net income	(d) Disbursements for charitable purposes (cash basis only)
Revenue	1 Contributions, gifts, grants, etc., received (attach schedule)				
	2 Check ☒ if the foundation is not required to attach Sch. B				
	3 Interest on savings and temporary cash investments	38	38		
	4 Dividends and interest from securities	18,818	18,818		
	5a Gross rents				
	b Net rental income or (loss)				
	6a Net gain or (loss) from sale of assets not on line 10	18,696			
	b Gross sales price of all assets on line 6a	18,696			
	7 Capital gain net income (from Part II, line 2)		18,696		
	8 Net short-term capital gain				
Operating and Administrative Expenses	9 Income modifications				
	10a Gross sales less returns and allowances				
	b Less Cost of goods sold				
	c Gross profit or (loss) (attach schedule)				
	11 Other income (attach schedule)				
	12 Total. Add lines 1 through 11	37,552	37,552		
	13 Compensation of officers, directors, trustees, etc.				
	14 Other employee salaries and wages				
	15 Pension plans, employee benefits				
	16a Legal fees (attach schedule) STM107	919	230	689	
	b Accounting fees (attach schedule) STM108	4,250		4,250	
	c Other professional fees (attach schedule)				
	17 Interest				
	18 Taxes (attach schedule) (see instructions) STM110	954	15		
	19 Depreciation (attach schedule) and depletion				
	20 Occupancy				
	21 Travel, conferences, and meetings				
22 Printing and publications					
23 Other expenses (attach schedule) STM103	140	140			
24 Total operating and administrative expenses. Add lines 13 through 23	6,263	385	4,939		
25 Contributions, gifts, grants paid	32,616		32,616		
26 Total expenses and disbursements. Add lines 24 and 25	38,879	385	37,555		
27 Subtract line 26 from line 12					
a Excess of revenue over expenses and disbursements	(1,327)				
b Net investment income (if negative, enter -0-)		37,167			
c Adjusted net income (if negative, enter -0-)			0		

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Part II Balance Sheets

Attached schedules and amounts in the description column should be for end-of-year amounts only (See instructions)

Beginning of year

End of year

(a) Book Value

(b) Book Value

(c) Fair Market Value

Assets

1	Cash - non-interest-bearing	71,776	44,293	44,293
2	Savings and temporary cash investments			
3	Accounts receivable ▶			
	Less: allowance for doubtful accounts ▶			
4	Pledges receivable ▶			
	Less: allowance for doubtful accounts ▶			
5	Grants receivable			
6	Receivables due from officers, directors, trustees, and other disqualified persons (attach schedule) (see instructions)			
7	Other notes and loans receivable (attach schedule) ▶			
	Less: allowance for doubtful accounts ▶			
8	Inventories for sale or use			
9	Prepaid expenses and deferred charges			
10a	Investments - U S and state government obligations (attach schedule)	3,587	2,415	1,748
b	Investments - corporate stock (attach schedule)	526,573	553,993	652,038
c	Investments - corporate bonds (attach schedule)	119,335	119,335	122,436
11	Investments - land, buildings, and equipment basis ▶			
	Less: accumulated depreciation (attach schedule) ▶			
12	Investments - mortgage loans			
13	Investments - other (attach schedule)			
14	Land, buildings, and equipment basis ▶			
	Less: accumulated depreciation (attach schedule) ▶			
15	Other assets (describe ▶ STM120)	1,031	939	939
16	Total assets (to be completed by all filers - see the instructions. Also, see page 1, item I)	722,302	720,975	821,454

Liabilities

17	Accounts payable and accrued expenses			
18	Grants payable			
19	Deferred revenue			
20	Loans from officers, directors, trustees, and other disqualified persons			
21	Mortgages and other notes payable (attach schedule)			
22	Other liabilities (describe ▶)			
23	Total liabilities (add lines 17 through 22)	0	0	

Net Assets or Fund Balances

	Foundations that follow SFAS 117, check here ☐			
	and complete lines 24 through 26 and lines 30 and 31.			
24	Unrestricted			
25	Temporarily restricted			
26	Permanently restricted			
	Foundations that do not follow SFAS 117, check here ☒			
	and complete lines 27 through 31.			
27	Capital stock, trust principal, or current funds			
28	Paid-in or capital surplus, or land, bldg, and equipment fund			
29	Retained earnings, accumulated income, endowment, or other funds	722,302	720,975	
30	Total net assets or fund balances (see instructions)	722,302	720,975	
31	Total liabilities and net assets/fund balances (see instructions)	722,302	720,975	

Part III Analysis of Changes in Net Assets or Fund Balances

1	Total net assets or fund balances at beginning of year - Part II, column (a), line 30 (must agree with end-of-year figure reported on prior year's return)	1	722,302
2	Enter amount from Part I, line 27a	2	(1,327)
3	Other increases not included in line 2 (itemize) ▶	3	
4	Add lines 1, 2, and 3	4	720,975
5	Decreases not included in line 2 (itemize) ▶	5	
6	Total net assets or fund balances at end of year (line 4 minus line 5) - Part II, column (b), line 30	6	720,975

Part IV Capital Gains and Losses for Tax on Investment Income

(a) List and describe the kind(s) of property sold (e.g., real estate, 2-story brick warehouse, or common stock, 200 shs MLC Co)	(b) How acquired P-Purchase D-Donation	(c) Date acquired (mo., day, yr.)	(d) Date sold (mo., day, yr.)
1a capital gain distribution	P	01-01-2015	12-31-2016
b GNMA	P	01-01-2014	12-31-2016
c			
d			
e			

(e) Gross sales price	(f) Depreciation allowed (or allowable)	(g) Cost or other basis plus expense of sale	(h) Gain or (loss) (e) plus (f) minus (g)
a 18,685			18,685
b 11			11
c			
d			
e			

Complete only for assets showing gain in column (h) and owned by the foundation on 12/31/69

(i) F M V as of 12/31/69	(j) Adjusted basis as of 12/31/69	(k) Excess of col. (i) over col. (j), if any	(l) Gains (Col. (h) gain minus col. (k), but not less than -0-) or Losses (from col. (h))
a			18,685
b			11
c			
d			
e			

2 Capital gain net income or (net capital loss) { If gain, also enter in Part I, line 7 If (loss), enter -0- in Part I, line 7 }	2	18,696
3 Net short-term capital gain or (loss) as defined in sections 1222(5) and (6) If gain, also enter in Part I, line 8, column (c) (see instructions) If (loss), enter -0- in Part I, line 8 }	3	

Part V Qualification Under Section 4940(e) for Reduced Tax on Net Investment Income

(For optional use by domestic private foundations subject to the section 4940(a) tax on net investment income.)

If section 4940(d)(2) applies, leave this part blank.

Was the foundation liable for the section 4942 tax on the distributable amount of any year in the base period?

☐ Yes ☒ No

If "Yes," the foundation does not qualify under section 4940(e). Do not complete this part.

1 Enter the appropriate amount in each column for each year; see the instructions before making any entries

(a) Base period years Calendar year (or tax year beginning in)	(b) Adjusted qualifying distributions	(c) Net value of noncharitable-use assets	(d) Distribution ratio (col. (b) divided by col. (c))
2015	37,839	824,028	0.04592
2014	34,566	825,996	0.041848
2013	34,680	768,483	0.045128
2012	33,372	695,599	0.047976
2011	30,912	688,918	0.04487

2 Total of line 1, column (d)	2	0.225741
3 Average distribution ratio for the 5-year base period - divide the total on line 2 by 5, or by the number of years the foundation has been in existence if less than 5 years	3	0.045148
4 Enter the net value of noncharitable-use assets for 2016 from Part X, line 5	4	804,275
5 Multiply line 4 by line 3	5	36,311
6 Enter 1% of net investment income (1% of Part I, line 27b)	6	372
7 Add lines 5 and 6	7	36,683
8 Enter qualifying distributions from Part XII, line 4 If line 8 is equal to or greater than line 7, check the box in Part VI, line 1b, and complete that part using a 1% tax rate. See the Part VI instructions	8	37,555

Part VI Excise Tax Based on Investment Income (Section 4940(a), 4940(b), 4940(e), or 4948 - see instructions)

1a	Exempt operating foundations described in section 4940(d)(2), check here ☐ and enter "N/A" on line 1 Date of ruling or determination letter _____ (attach copy of letter if necessary-see instructions)		
b	Domestic foundations that meet the section 4940(e) requirements in Part V, check here ☒ and enter 1% of Part I, line 27b	1	372
c	All other domestic foundations enter 2% of line 27b Exempt foreign organizations enter 4% of Part I, line 12, col (b)		
2	Tax under section 511 (domestic section 4947(a)(1) trusts and taxable foundations only Others enter -0-)	2	0
3	Add lines 1 and 2	3	372
4	Subtitle A (income) tax (domestic section 4947(a)(1) trusts and taxable foundations only Others enter -0-)	4	0
5	Tax based on investment income. Subtract line 4 from line 3 If zero or less, enter -0-	5	372
6	Credits/Payments:		
a	2016 estimated tax payments and 2015 overpayment credited to 2016	6a	939
b	Exempt foreign organizations - tax withheld at source	6b	
c	Tax paid with application for extension of time to file (Form 8868)	6c	
d	Backup withholding erroneously withheld	6d	
7	Total credits and payments Add lines 6a through 6d	7	939
8	Enter any penalty for underpayment of estimated tax Check here ☐ if Form 2220 is attached	8	
9	Tax due. If the total of lines 5 and 8 is more than line 7, enter amount owed	9	
10	Overpayment. If line 7 is more than the total of lines 5 and 8, enter the amount overpaid	10	567
11	Enter the amount of line 10 to be Credited to 2017 estimated tax 567 Refunded	11	

Part VII-A Statements Regarding Activities

	Yes	No
1a During the tax year, did the foundation attempt to influence any national, state, or local legislation or did it participate or intervene in any political campaign?		X
b Did it spend more than \$100 during the year (either directly or indirectly) for political purposes (see Instructions for the definition)? <i>If the answer is "Yes" to 1a or 1b, attach a detailed description of the activities and copies of any materials published or distributed by the foundation in connection with the activities.</i>		X
c Did the foundation file Form 1120-POL for this year?		X
d Enter the amount (if any) of tax on political expenditures (section 4955) imposed during the year (1) On the foundation \$ _____ (2) On foundation managers \$ _____		
e Enter the reimbursement (if any) paid by the foundation during the year for political expenditure tax imposed on foundation managers. \$ _____		
2 Has the foundation engaged in any activities that have not previously been reported to the IRS? <i>If "Yes," attach a detailed description of the activities</i>		X
3 Has the foundation made any changes, not previously reported to the IRS, in its governing instrument, articles of incorporation, or bylaws, or other similar instruments? <i>If "Yes," attach a conformed copy of the changes</i>		X
4a Did the foundation have unrelated business gross income of \$1,000 or more during the year?		X
b If "Yes," has it filed a tax return on Form 990-T for this year?		
5 Was there a liquidation, termination, dissolution, or substantial contraction during the year? <i>If "Yes," attach the statement required by General Instruction T.</i>		X
6 Are the requirements of section 508(e) (relating to sections 4941 through 4945) satisfied either • By language in the governing instrument, or • By state legislation that effectively amends the governing instrument so that no mandatory directions that conflict with the state law remain in the governing instrument?	X	
7 Did the foundation have at least \$5,000 in assets at any time during the year? <i>If "Yes," complete Part II, col (c), and Part XV</i>	X	
8a Enter the states to which the foundation reports or with which it is registered (see instructions) FL IL		
b If the answer is "Yes" to line 7, has the foundation furnished a copy of Form 990-PF to the Attorney General (or designate) of each state as required by <i>General Instruction G</i> ? <i>If "No," attach explanation</i>	X	
9 Is the foundation claiming status as a private operating foundation within the meaning of section 4942(j)(3) or 4942(j)(5) for calendar year 2016 or the taxable year beginning in 2016 (see instructions for Part XIV)? <i>If "Yes," complete Part XIV</i>		X
10 Did any persons become substantial contributors during the tax year? <i>If "Yes," attach a schedule listing their names and addresses</i>		X

Part VII-A Statements Regarding Activities (continued)

11	At any time during the year, did the foundation, directly or indirectly, own a controlled entity within the meaning of section 512(b)(13)? If "Yes," attach schedule (see instructions)	11	Yes	No
12	Did the foundation make a distribution to a donor advised fund over which the foundation or a disqualified person had advisory privileges? If "Yes," attach statement (see instructions)	12		X
13	Did the foundation comply with the public inspection requirements for its annual returns and exemption application?	13	X	
Website address ▶ <u>N/A</u>				
14	The books are in care of ▶ <u>John Swaun</u>	Telephone no	▶ <u>305-722-4372</u>	
	Located at ▶ <u>PO Box 970103, Miami, FL</u>	ZIP+4	▶ <u>33197-0103</u>	
15	Section 4947(a)(1) nonexempt charitable trusts filing Form 990-PF in lieu of Form 1041-Check here	▶ ☐		
	and enter the amount of tax-exempt interest received or accrued during the year	15		
16	At any time during calendar year 2016, did the foundation have an interest in or a signature or other authority over a bank, securities, or other financial account in a foreign country?	16	Yes	No
	See the instructions for exceptions and filing requirements for FinCEN Form 114. If "Yes," enter the name of the foreign country ▶			X

Part VII-B Statements Regarding Activities for Which Form 4720 May Be Required

File Form 4720 if any item is checked in the "Yes" column, unless an exception applies.

1a	During the year did the foundation (either directly or indirectly)		Yes	No
(1)	Engage in the sale or exchange, or leasing of property with a disqualified person?	☐ Yes	☒ No	
(2)	Borrow money from, lend money to, or otherwise extend credit to (or accept it from) a disqualified person?	☐ Yes	☒ No	
(3)	Furnish goods, services, or facilities to (or accept them from) a disqualified person?	☐ Yes	☒ No	
(4)	Pay compensation to, or pay or reimburse the expenses of, a disqualified person?	☒ Yes	☐ No	
(5)	Transfer any income or assets to a disqualified person (or make any of either available for the benefit or use of a disqualified person)?	☐ Yes	☒ No	
(6)	Agree to pay money or property to a government official? (Exception. Check "No" if the foundation agreed to make a grant to or to employ the official for a period after termination of government service, if terminating within 90 days)	☐ Yes	☒ No	
b	If any answer is "Yes" to 1a(1)-(6), did any of the acts fail to qualify under the exceptions described in Regulations section 53.4941(d)-3 or in a current notice regarding disaster assistance (see instructions)?			X
	Organizations relying on a current notice regarding disaster assistance check here	▶ ☐		
c	Did the foundation engage in a prior year in any of the acts described in 1a, other than excepted acts, that were not corrected before the first day of the tax year beginning in 2016?			X
2	Taxes on failure to distribute income (section 4942) (does not apply for years the foundation was a private operating foundation defined in section 4942(j)(3) or 4942(j)(5))			
a	At the end of tax year 2016, did the foundation have any undistributed income (lines 6d and 6e, Part XIII) for tax year(s) beginning before 2016?	☐ Yes	☒ No	
	If "Yes," list the years ▶			
b	Are there any years listed in 2a for which the foundation is not applying the provisions of section 4942(a)(2) (relating to incorrect valuation of assets) to the year's undistributed income? (If applying section 4942(a)(2) to all years listed, answer "No" and attach statement - see instructions)			
c	If the provisions of section 4942(a)(2) are being applied to any of the years listed in 2a, list the years here	▶		
3a	Did the foundation hold more than a 2% direct or indirect interest in any business enterprise at any time during the year?	☐ Yes	☒ No	
b	If "Yes," did it have excess business holdings in 2016 as a result of (1) any purchase by the foundation or disqualified persons after May 26, 1969, (2) the lapse of the 5-year period (or longer period approved by the Commissioner under section 4943(c)(7)) to dispose of holdings acquired by gift or bequest, or (3) the lapse of the 10-, 15-, or 20-year first phase holding period? (Use Schedule C, Form 4720, to determine if the foundation had excess business holdings in 2016)			
4a	Did the foundation invest during the year any amount in a manner that would jeopardize its charitable purposes?			X
b	Did the foundation make any investment in a prior year (but after December 31, 1969) that could jeopardize its charitable purpose that had not been removed from jeopardy before the first day of the tax year beginning in 2016?			X

Part VII-B Statements Regarding Activities for Which Form 4720 May Be Required (continued)**5a** During the year did the foundation pay or incur any amount to:(1) Carry on propaganda, or otherwise attempt to influence legislation (section 4945(e))? ☐ Yes ☒ No(2) Influence the outcome of any specific public election (see section 4955), or to carry on, directly or indirectly, any voter registration drive? ☐ Yes ☒ No(3) Provide a grant to an individual for travel, study, or other similar purposes? ☐ Yes ☒ No(4) Provide a grant to an organization other than a charitable, etc., organization described in section 4945(d)(4)(A)? (see instructions) ☐ Yes ☒ No(5) Provide for any purpose other than religious, charitable, scientific, literary, or educational purposes, or for the prevention of cruelty to children or animals? ☐ Yes ☒ No**b** If any answer is "Yes" to 5a(1)-(5), did any of the transactions fail to qualify under the exceptions described in Regulations section 53.4945 or in a current notice regarding disaster assistance (see instructions)? ☐Organizations relying on a current notice regarding disaster assistance check here ☐**c** If the answer is "Yes" to question 5a(4), does the foundation claim exemption from the tax because it maintained expenditure responsibility for the grant? ☐ Yes ☐ No

If "Yes," attach the statement required by Regulations section 53.4945-5(d)

6a Did the foundation, during the year, receive any funds, directly or indirectly, to pay premiums on a personal benefit contract? ☐ Yes ☒ No**b** Did the foundation, during the year, pay premiums, directly or indirectly, on a personal benefit contract? ☐ Yes ☒ No

If "Yes" to 6b, file Form 8870

7a At any time during the tax year, was the foundation a party to a prohibited tax shelter transaction? ☐ Yes ☒ No**b** If "Yes," did the foundation receive any proceeds or have any net income attributable to the transaction? ☐ Yes ☒ No**Part VIII Information About Officers, Directors, Trustees, Foundation Managers, Highly Paid Employees, and Contractors****1** List all officers, directors, trustees, foundation managers and their compensation (see instructions).

(a) Name and address	(b) Title, and average hours per week devoted to position	(c) Compensation (If not paid, enter -0-)	(d) Contributions to employee benefit plans and deferred compensation	(e) Expense account, other allowances
schedule attached	1	0	0	0

2 Compensation of five highest-paid employees (other than those included on line 1 - see instructions). If none, enter "NONE."

(a) Name and address of each employee paid more than \$50,000	(b) Title, and average hours per week devoted to position	(c) Compensation	(d) Contributions to employee benefit plans and deferred compensation	(e) Expense account, other allowances
NONE				

Total number of other employees paid over \$50,000 ☐ 0

Part VIII Information About Officers, Directors, Trustees, Foundation Managers, Highly Paid Employees, and Contractors (continued)**3** Five highest-paid independent contractors for professional services (see instructions). If none, enter "NONE."

(a) Name and address of each person paid more than \$50,000	(b) Type of service	(c) Compensation
NONE		
Total number of others receiving over \$50,000 for professional services		▶

Part IX-A Summary of Direct Charitable Activities

List the foundation's four largest direct charitable activities during the tax year. Include relevant statistical information such as the number of organizations and other beneficiaries served, conferences convened, research papers produced, etc.	Expenses
1 The Trust is not involved in any direct charitable activities	0
2 4% of the Fair Market Value of the Trust's Assets (averaged over 3 preceding years) are contributed to the University of Illinois	0
3 which does Broom Corn research. Statement of research activities are attached	0
4	

Part IX-B Summary of Program-Related Investments (see instructions)

Describe the two largest program-related investments made by the foundation during the tax year on lines 1 and 2	Amount
1 NONE	0
2	
All other program-related investments See instructions	
3	
Total. Add lines 1 through 3	▶

Part X Minimum Investment Return (All domestic foundations must complete this part. Foreign foundations, see instructions.)

1	Fair market value of assets not used (or held for use) directly in carrying out charitable, etc., purposes		
a	Average monthly fair market value of securities	1a	744,983
b	Average of monthly cash balances	1b	71,540
c	Fair market value of all other assets (see instructions)	1c	0
d	Total (add lines 1a, b, and c)	1d	816,523
e	Reduction claimed for blockage or other factors reported on lines 1a and 1c (attach detailed explanation)	1e	
2	Acquisition indebtedness applicable to line 1 assets	2	0
3	Subtract line 2 from line 1d	3	816,523
4	Cash deemed held for charitable activities. Enter 1 1/2% of line 3 (for greater amount, see instructions)	4	12,248
5	Net value of noncharitable-use assets. Subtract line 4 from line 3. Enter here and on Part V, line 4	5	804,275
6	Minimum investment return. Enter 5% of line 5	6	40,214

Part XI Distributable Amount (see instructions) (Section 4942(j)(3) and (j)(5) private operating foundations and certain foreign organizations check here ☐ and do not complete this part)

1	Minimum investment return from Part X, line 6	1	40,214
2a	Tax on investment income for 2016 from Part VI, line 5	2a	372
b	Income tax for 2016 (This does not include the tax from Part VI)	2b	
c	Add lines 2a and 2b	2c	372
3	Distributable amount before adjustments. Subtract line 2c from line 1	3	39,842
4	Recoveries of amounts treated as qualifying distributions	4	
5	Add lines 3 and 4	5	39,842
6	Deduction from distributable amount (see instructions)	6	
7	Distributable amount as adjusted. Subtract line 6 from line 5. Enter here and on Part XIII, line 1	7	39,842

Part XII Qualifying Distributions (see instructions)

1	Amounts paid (including administrative expenses) to accomplish charitable, etc., purposes		
a	Expenses, contributions, gifts, etc. - total from Part I, column (d), line 26	1a	37,555
b	Program-related investments - total from Part IX-B	1b	
2	Amounts paid to acquire assets used (or held for use) directly in carrying out charitable, etc., purposes	2	
3	Amounts set aside for specific charitable projects that satisfy the:		
a	Suitability test (prior IRS approval required)	3a	
b	Cash distribution test (attach the required schedule)	3b	
4	Qualifying distributions. Add lines 1a through 3b. Enter here and on Part V, line 8, and Part XIII, line 4	4	37,555
5	Foundations that qualify under section 4940(e) for the reduced rate of tax on net investment income. Enter 1% of Part I, line 27b (see instructions)	5	372
6	Adjusted qualifying distributions. Subtract line 5 from line 4	6	37,183

Note: The amount on line 6 will be used in Part V, column (b), in subsequent years when calculating whether the foundation qualifies for the section 4940(e) reduction of tax in those years.

Part XIII Undistributed Income (see instructions)

	(a) Corpus	(b) Years prior to 2015	(c) 2015	(d) 2016
1 Distributable amount for 2016 from Part XI, line 7				
2 Undistributed income, if any, as of the end of 2016:				
a Enter amount for 2015 only				
b Total for prior years:				39,842
3 Excess distributions carryover, if any, to 2016:				
a From 2011			8,399	
b From 2012				
c From 2013				
d From 2014				
e From 2015				
f Total of lines 3a through e				
4 Qualifying distributions for 2016 from Part XII, line 4. ▶ \$ 37,555				
a Applied to 2015, but not more than line 2a				
b Applied to undistributed income of prior years (Election required - see instructions)			8,399	
c Treated as distributions out of corpus (Election required - see instructions)				
d Applied to 2016 distributable amount				
e Remaining amount distributed out of corpus				
5 Excess distributions carryover applied to 2016 (If an amount appears in column (d), the same amount must be shown in column (a))				29,156
6 Enter the net total of each column as indicated below:				
a Corpus. Add lines 3f, 4c, and 4e. Subtract line 5				
b Prior years' undistributed income. Subtract line 4b from line 2b				
c Enter the amount of prior years' undistributed income for which a notice of deficiency has been issued, or on which the section 4942(a) tax has been previously assessed				
d Subtract line 6c from line 6b. Taxable amount - see instructions				
e Undistributed income for 2015. Subtract line 4a from line 2a. Taxable amount - see instructions				
f Undistributed income for 2016. Subtract lines 4d and 5 from line 1. This amount must be distributed in 2017				
7 Amounts treated as distributions out of corpus to satisfy requirements imposed by section 170(b)(1)(F) or 4942(g)(3) (Election may be required - see instructions)				10,686
8 Excess distributions carryover from 2011 not applied on line 5 or line 7 (see instructions)				
9 Excess distributions carryover to 2017. Subtract lines 7 and 8 from line 6a				
10 Analysis of line 9:				
a Excess from 2012				
b Excess from 2013				
c Excess from 2014				
d Excess from 2015				
e Excess from 2016				

Part XIV Private Operating Foundations (see instructions and Part VII-A, question 9)

1a If the foundation has received a ruling or determination letter that it is a private operating foundation, and the ruling is effective for 2016, enter the date of the ruling ▶

b Check box to indicate whether the foundation is a private operating foundation described in section ☐ 4942(j)(3) or ☐ 4942(j)(5)

	Tax year	Prior 3 years			(e) Total
	(a) 2016	(b) 2015	(c) 2014	(d) 2013	
2a Enter the lesser of the adjusted net income from Part I or the minimum investment return from Part X for each year listed					
b 85% of line 2a					
c Qualifying distributions from Part XII, line 4 for each year listed					
d Amounts included in line 2c not used directly for active conduct of exempt activities					
e Qualifying distributions made directly for active conduct of exempt activities. Subtract line 2d from line 2c					
3 Complete 3a, b, or c for the alternative test relied upon:					
a "Assets" alternative test - enter					
(1) Value of all assets					
(2) Value of assets qualifying under section 4942(j)(3)(B)(i)					
b "Endowment" alternative test - enter 2/3 of minimum investment return shown in Part X, line 6 for each year listed					
c "Support" alternative test - enter					
(1) Total support other than gross investment income (interest, dividends, rents, payments on securities loans (section 512(a)(5)), or royalties)					
(2) Support from general public and 5 or more exempt organizations as provided in section 4942(j)(3)(B)(iii)					
(3) Largest amount of support from an exempt organization					
(4) Gross investment income					

Part XV Supplementary Information (Complete this part only if the foundation had \$5,000 or more in assets at any time during the year - see instructions.)**1 Information Regarding Foundation Managers:**

a List any managers of the foundation who have contributed more than 2% of the total contributions received by the foundation before the close of any tax year (but only if they have contributed more than \$5,000) (See section 507(d)(2))

NONE

b List any managers of the foundation who own 10% or more of the stock of a corporation (or an equally large portion of the ownership of a partnership or other entity) of which the foundation has a 10% or greater interest

NONE

2 Information Regarding Contribution, Grant, Gift, Loan, Scholarship, etc., Programs:

Check here ☐ if the foundation only makes contributions to preselected charitable organizations and does not accept unsolicited requests for funds. If the foundation makes gifts, grants, etc. (see instructions) to individuals or organizations under other conditions, complete items 2a, b, c, and d

a The name, address, and telephone number or e-mail address of the person to whom applications should be addressed.

990APP

b The form in which applications should be submitted and information and materials they should include

c Any submission deadlines

d Any restrictions or limitations on awards, such as by geographical areas, charitable fields, kinds of institutions, or other factors:

Part XV Supplementary Information (continued)**3 Grants and Contributions Paid During the Year or Approved for Future Payment**

Recipient Name and address (home or business)	If recipient is an individual, show any relationship to any foundation manager or substantial contributor	Foundation status of recipient	Purpose of grant or contribution	Amount
a Paid during the year University of Illinois 1305 West Green Street Urbana, IL 61801-2962	N/A	PC	Broom Corn Research	32,616
Total			3a	32,616
b Approved for future payment University of Illinois 1305 West Green Street Urbana, IL 61801-2962	N/A	PC	Broom Corn Research	32,709
Total			3b	32,709

Part XVI-A Analysis of Income-Producing Activities

Enter gross amounts unless otherwise indicated

	Unrelated business income		Excluded by section 512, 513, or 514		(e) Related or exempt function income (See instructions)
	(a) Business code	(b) Amount	(c) Exclusion code	(d) Amount	
1 Program service revenue					
a _____					
b _____					
c _____					
d _____					
e _____					
f _____					
g Fees and contracts from government agencies					
2 Membership dues and assessments					
3 Interest on savings and temporary cash investments		38	14		
4 Dividends and interest from securities		18,818	14		
5 Net rental income or (loss) from real estate					
a Debt-financed property					
b Not debt-financed property					
6 Net rental income or (loss) from personal property					
7 Other investment income					
8 Gain or (loss) from sales of assets other than inventory		18,696	18		
9 Net income or (loss) from special events					
10 Gross profit or (loss) from sales of inventory					
11 Other revenue a _____					
b _____					
c _____					
d _____					
e _____					
12 Subtotal Add columns (b), (d), and (e)		37,552			
13 Total. Add line 12, columns (b), (d), and (e)					37,552

(See worksheet in line 13 instructions to verify calculations.)

Part XVI-B Relationship of Activities to the Accomplishment of Exempt Purposes

Line No.



Explain below how each activity for which income is reported in column (e) of Part XVI-A contributed importantly to the accomplishment of the foundation's exempt purposes (other than by providing funds for such purposes) (See instructions)

01a Not Applicable

Information Regarding Transfers To and Transactions With Noncharitable Exempt Organizations

	Yes	No
1a(1)		X
1a(2)		X
1b(1)		X
1b(2)		X
1b(3)		X
1b(4)		X
1b(5)		X
1b(6)		X
1c		X

[illegible]

- 2a** Is the foundation directly or indirectly affiliated with, or related to, one or more tax-exempt organizations described in section 501(c) of the Code (other than section 501(c)(3)) or in section 527? ☐ Yes ☒ No
- b** If "Yes," complete the following schedule

(a) Name of organization	(b) Type of organization	(c) Description of relationship

305-722-4372

NOLAN BROOM CORN TRUST
FORM 990PF - 59-6566127
2016

Page 1

column

	(a)	(b)	(d)
Part I Line 16-A			
legal fees			
Balbach Law Offices, P.C.	919	230	689

Part I Line 16-B

accounting fees			
John W. Swaun	4,250	0	4,250

Part I Line 18-Taxes

state tax	15	15	0
excise tax on 2015 net investment income	939	0	0

line 18	954	15	0
---------	-----	----	---

Part I Line 23
other expenses

bank charges	140	140	0
--------------	-----	-----	---

NOLAN BROOM CORN TRUST
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2016

Page 2

end of year

book	value	f.m.v.
------	-------	--------

Part II - Balance Sheet
Line 10-A

G.N.M.A. - 9 ½%	11-20-20	432	15
G.N.M.A. - 8%	7-20-24	00	61
G.N.M.A. - 5 ½%	12-15-37	1,983	1,672
Line 10-A		2,415	1,748

NOLAN BROOM CORN TRUST
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2016

Page 2		end of year	
Part II - Balance Sheet		Book Value	FMV
Line 10-B Corporate Stock		(B)	C
3561 Amcap Funds		73,849	96,983
885 Capital Income		47,668	51,031
1782 Capital World Growth		64,339	78,108
2904 Growth Fund America		92,435	122,093
1924 Small Cap World		68,236	88,472
3732 Wash Mutual Investors		121,427	152,864
Sub Total		467,954	589,551
General Motors Stock & Wts		26,059	8,988
830 Guggenheim builder		20,051	17,770
490 Ishare		19,989	18,233
480 SPDR Barclays		19,940	17,496
Page 2 Line 10-B		553,993	652,038

NOLAN BROOM CORN TRUST
FORM 990PF - 59-6566127
2016

Page 2				end of year	
				Book Value	FMV
Part II - Balance Sheet				(B)	(C)
Line 10-C Bonds					
10,000	Gen Mtrs	7.2%	1-15-11	-0-	-0-
20,000	Dell	7.1%	4-15-28	19,829	20,898
15,000	Gen Mtrs	7.2%	1-15-11	-0-	-0-
10,000	Sears	6.875%	10-15-17	10,805	9,350
48,000	Wachovia	5.75%	2-01-18	48,897	49,987
40,000	Gen Elec	5.625	5-01-18	39,804	42,201
Page 2 Line 10-C				119,335	122,436

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2017

end of year

Book Value FMV

Part II Line 15

B

C

Deposits

939

939

NOLAN BROOM CORN TRUST
FORM 990-PF 59-6566127

(A)	(B)	(C)	(D)	(E)
John W. Swaun P. O. Box 970103 Miami, Florida 33197	Trustee as needed	-0-	-0-	-0-
Thomas F. Monahan 202 N. Oak P. O. Box 250 Arcola, Illinois 61910	Trustee as needed	-0-	-0-	-0-
Dr Samuel E. Moyer 911 Larkspur Place, South Mt Laurel, NJ 08054-4900	Trustee as needed	-0-	-0-	-0-
Stephen Moose, PhD 1201 W Gregory Drive 389 Edward R. Madigan Laboratory Urbana, Illinois 61801	Trustee as needed	-0-	-0-	-0-
Patrick James Brown 1206 W. Gregory Drive Urbana, Illinois 61801	Trustee as needed	-0-	-0-	-0-

Federal Supporting Statements**2016 PG01**

Name(s) as shown on return

Your Social Security Number

Nolan Broom Corn Trust

59-6566127

Form 990PF - Part XV - Line 2
Application Submission Information**Grant Program**

Broom Corn Research

Applicant Name

Steven Moose

Address1201 W Gregory Drive
Urbana, IL 61801**Telephone**

217-244-6308

Email Address**Form & Content**

any form

Submission Deadline

none

Restrictions on Award

Broom Corn Research

Thank you for your gift

in support of the University of Illinois

Nolan Broom Corn Trust
ATTN: Mr. Stephen P. Moose
1201 W Gregory Dr
Urbana, IL 61801-3873

Tax Receipt Number: rev-15755627
Gift Date: 12/9/2016

Gift Designation
Nolan Broomcorn Fund

Gift Value
\$32,616.00

Gift Information
For research conducted by Drs. Stephen Moose and Patrick Brown

Amount Received: \$32,616.00

Your gift has been received by the University of Illinois Foundation and will be directed to the area you have designated. The Foundation certifies that you have received no goods or services in exchange for this contribution, unless stated on this receipt.

Please keep this official receipt for your income tax purposes.

We are grateful for your investment in the University's teaching, research, public service, and economic development mission.

Christine C Devocelle

Chief Financial Officer and Senior Vice President
University of Illinois Foundation

5229134



University of Illinois Foundation



UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Department of Crop Sciences

389 Edward R. Madigan Laboratory
1201 W Gregory Drive
Urbana, IL 61801-4798



November 19, 2016

Trustees of the Nolan Broom Corn Trust
c/o S. Byron Balbach, Jr.
Balbach Law Offices, PC
123 W. Main Street, Suite 200
PO Box 217
Urbana, IL 61803

Dear Distinguished Trustees of the Nolan Broom Corn Trust,

The following reports on the activities at the University of Illinois since our last report in November, 2015. I include the results from our 2015 broomcorn evaluations that were analyzed in spring 2016, which were then used to make selections for entries in the 2016 evaluation and seed increase. Jessica Bubert, my graduate student, led all of the broomcorn efforts as one component of her Ph.D. research in plant breeding. She presented her research with broomcorn genetic as a poster at the annual meetings of the Crop Science Society of America, a page-size version of the poster is attached. One of the undergraduate students who worked with Jessica in measuring broomcorn traits, Abby Vanderkloot, presented some broomcorn research as a poster at the annual campus student research symposium.

1. Continue selections for desirable broomcorn traits. A total of 45 broomcorn accessions were planted in 2015. These include the two populations Hadley Ornamental and Moyer Main Gene Pool Mix. Eight of these accessions showed very poor germination, and we observed these same accessions showed poor germination in previous years, indicating a likely genetic basis for low quality of seed produced. At least 5 broomheads (panicles) from each of the remaining accessions were measured for the following traits: plant height, brush length (from peduncle to where seeds form), total panicle length from peduncle to tip, length from tip to end of seed formation, and frequency of "curved" or "crooked" panicles. We then calculated a "broomscore" where the total length of the panicle was divided by the ratio of the seed and non-seed portions of the panicle. We also used a binary scoring for the degree of fusion of central branches, a value of 1 if one-fourth or more of the total panicle length had fused branches, and a value of 0 if less than one-fourth. Desirable broomcorns will have long panicle branches with seeds concentrated at the end, no crooks, and no fusion of central branches.

A summary of these important measures for the five accessions with the highest broomscores, zero curved panicles, and low branch fusion is given in the table on the following page. Also included in this table are values for Deer and Sam Moyer's Main Gene Pool Mix. Pictures of representative panicles from each of these seven accessions are also shown. Both the pictures and the data show that the IL02, IL03, IS1360 and Moyer Main Gene Pool Mix have similar panicles that are distinct in form and color from Deer. However, IS1360 shows a high frequency of crooks at the base and plants are nearly twice as tall as the other accessions with the

highest broomscores, which makes it less desirable. IL10 and Mn2835 produced above average broomscores, and slightly better than Deer, but have a distinctive morphology and darker color.

Table 1: Important panicle traits among high broomscore accessions grown at Urbana in 2015.

Plot	Genotype	Panicles Measured	Brush length (cm)	Seed Length (cm)	Total Length (cm)	Broom score	Crooks	Plant Height (cm)
151048	IL03	87	54 ± 8	9 ± 6	63 ± 6	450	0.02	161 ± 14
151016	IL02	144	53 ± 6	8 ± 2	61 ± 7	415	0.20	167 ± 10
151107	Moyer Main Gene Pool Mix	41	51 ± 12	12 ± 7	63 ± 10	336	0.05	121 ± 6
151079	IS13060	12	58 ± 10	17 ± 5	74 ± 10	291	0.92	338 ± 5
151040	IL10	10	53 ± 6	15 ± 5	68 ± 8	257	0.00	210 ± 38
151041	Mn2835	39	50 ± 17	17 ± 6	68 ± 6	233	0.13	220 ± 14
151086	Deer	24	47 ± 22	21 ± 9	68 ± 19	218	0.00	228 ± 15
2015 Mean 37 genotypes			39 ± 15	16 ± 5	55 ± 13	209	0.23	252 ± 17

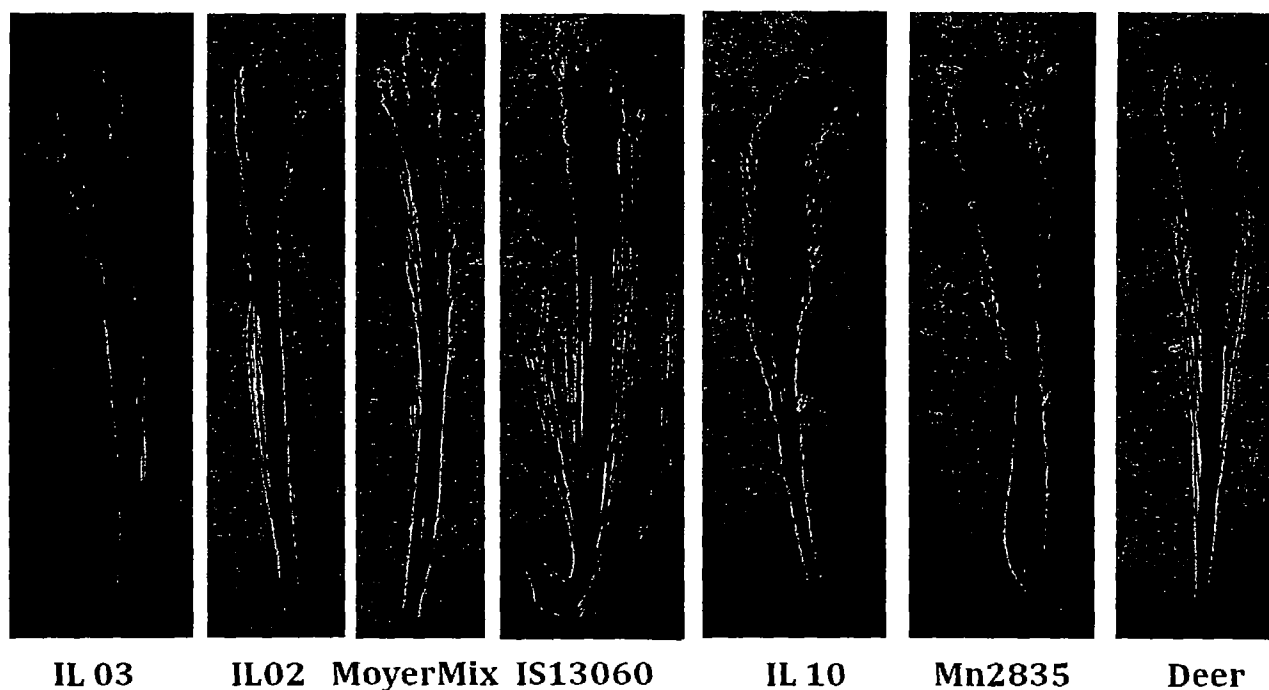


Figure 1: Pictures of 2015 Illinois broomcorn accessions with high broomscores

Forty-four broomcorn accessions were planted in 2016 at the University of Illinois Energy Farm, as summarized in Appendix A. Single rows were planted for most accessions to observe stability of plant and broomcorn traits, but multiple rows were planted with each of the accessions shown in Figure 1. The field location was managed by Trustee Patrick Brown, and all field activities were coordinated on daily basis by Derek Lewis, a research specialist who works jointly with Trustees Moose and Brown to conduct field research in support of corn and sorghum breeding programs. Mr. Lewis' salary and benefits are currently paid by external grant funds which continue through August 2017. As in recent years, some of the Trust funds distributed to the University were used for maintenance and minor repairs of the tractor and precision planter, field rental costs, and other supplies needed to produce and harvest pure seed.

Derek Lewis, Jessica Bubert, and a team of undergraduate students collected the same data on the 2016 plantings as in 2014 and 2015, which will give us three seasons of evaluation. Trustee Monahan visited the Urbana plots in early September and provided useful observations for desirable traits, including reduced tillering in some of the newer varieties to favor production of one large panicle with long brush. We did observe among some of the taller broomcorn accessions a few relatively short plants that likely contain known dwarfing genes present in U.S. sorghum germplasm. For the accessions with highest broomscores, we now have seed available for distribution to other interested parties. A good quantity (>20 pounds) of high quality seed for the Deer variety was produced, as well as the top new variety IL 02.

2. Genetic analysis of broomcorns. The analysis of the genetic diversity within the Illinois broomcorn collection is presented on the attached poster and revealed a number of interesting findings. A total of approximately 24,000 high quality genetic markers were obtained, distributed over the entire sorghum genome. Clustering based on genetic relatedness showed the available accessions could be divided into approximately 14 distinct sub-groups, indicating some genetic diversity among broomcorns. Many of the accessions with the highest broomscores fall into one of three closely related subgroups. One subgroup contains each of IL02, IL03 and Moyer Main Gene Pool Mix. As might be expected if selected from existing accessions that already exhibited higher broomscores, the four individuals from the Moyer Main Gene Pool Mix were closely related to three of the five groups associated with high broomscores. Importantly, none of the historical preferred broomcorns (Acme, Deer, Black Spanish) grouped with the high broomscore types, although Deer and Black Spanish are grouped together.

The genetic data were also used to test for individual DNA markers that showed a strong association with broomcorn traits. Although nearly 50 broomcorn accessions were used in this analysis, this is still a relatively small population and will only detect large genetic factors if present. The initial results did not identify strong genetic effects for either total panicle length or broomscore, suggesting that these traits may be controlled by multiple genes. However, more refined analyses comparing the groups with high compared to low broomscores may reveal the most important factors. Ongoing are analyses to compare broomcorns, and in particular those with preferred broomcorn trait values, to a broader set of sorghum genotypes to determine what markers might uniquely be associated with desired broomcorn traits. Both of these studies will benefit from the populations being created from crosses between high and low broomscore parents.

3. Self-pollinate the hybrids between high broomscore lines and BTx623. To help further define gene-trait associations for broomcorn, it is necessary to produce populations derived from

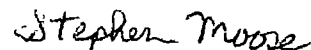
crosses between broomcorn and conventional grain sorghum types, which will then show variation for "broominess", and the genes that control such traits. We initiated such populations in 2014 by crossing desirable broomcorn types to the BTx623 grain sorghum inbred with cytoplasmic male sterile trait, which greatly reduces self-pollination. Seed was successfully generated from crosses with six high broomscores, and planted in the 2015 nursery. Unfortunately, we did not obtain quality seed from the putative hybrids grown in 2015 due to mold forming in the pollination bags, so the putative hybrids were planted again in 2016. Some of the putative hybrids were visually obvious due to their vigor, and multiple heads from each of these rows were bagged for controlled self-pollination.

4. Planned Activities for 2017.

- a. Analyze the trait data collected from the 2016 field season, and combine this with the observations from prior years to determine heritability and stability of broomcorn traits.
- b. Complete analysis of the genetic data for broomcorn relationships to other sorghums and tests of associations with favorable broomcorn traits.
- c. Plant a broomcorn genetic nursery to increase seed of preferred varieties such as Deer, conduct further evaluation and selection of improved broomcorn lines, and determine mode of inheritance of desirable broom traits in segregating families.
- d. Explore the possibility of leveraging our research with broomcorn into a broader project aimed at studying the genetic basis for variation in sorghum panicle form. This project will be proposed to the National Science Foundation in collaboration with scientists from the Donald Danforth Plant Sciences Center and Kansas State University. If supported, it would increase the resources for studying broomcorn traits.

Any questions or discussion regarding the above plans is welcomed.

Respectfully submitted,



Stephen Moose
Denton and Elizabeth Alexander Professor
of Maize Breeding and Genetics

Appendix A –Illinois Broomcorn Plantings for 2016

Plot ID	Genotype
166000	Acme
166001	Bezra
166002	Black_Span
166003	Black_Span
166004	cms
166005	Broomcorn population Moyer Main Gene Pool Mix
166006	Broomcorn population Moyer Main Gene Pool Mix
166007	Broomcorn population Moyer Main Gene Pool Mix
166008	Broomcorn population Moyer Main Gene Pool Mix
166009	Fruhe_Rote_nroom
166010	Hadley Ornamental
166011	IL_02
166012	IL_02
166013	IL_02
166014	IL_02
166015	IL_02
166016	IL_02
166017	IL_02
166018	IL_02
166019	IL_02
166020	IL_02
166021	IL_02
166022	IL_02
166023	IL_02
166024	IL_02
166025	IL_02
166026	IL_02
166027	IL_03
166028	IL_03
166029	IL_03
166030	IL_03
166031	IL_03
166032	IL_03
166033	IL_03
166034	IL_03
166035	IL_03
166036	IL_03
166037	IL_03
166038	cms

166039	IL_03
166040	IL_03
166041	IL_04
166042	IL_05
166043	IL_05
166044	IL_06
166045	IL_07
166046	IL_07
166047	IL_07
166048	IL_08
166049	IL_09
166050	IL_10
166051	IL_11
166052	IL_12
166053	IL_13
166054	IL_14
166055	IL_15
166056	IL_16
166057	IL_17
166058	IL_18
166059	IL_19
166060	IL_20
166061	IS13060
166062	cms
166063	IS2374
166064	Jap_Dwf
166065	Kataghan_1292
166066	Mn2835
166067	Mn2852
166068	Mn2869
166069	Mn2874
166070	Mn2874
166071	Mn2887
166072	Mn2889
166073	Mn2889
166074	Mn2892
166075	Mn2895
166076	cms
166077	Mn2895
166078	Mn2900
166079	Mn2902

166080	Mn2937
166081	Mn3370
166082	Mn3370
166083	Mn3370
166084	UI4834
166085	UI4836
166086	Btx623.ms3 x Bezra
166087	Btx623.ms3 x Black_Span
166088	Btx623 ms3 x IL_02
166089	Btx623 ms3 x Mn2902
166090	Deer
166091	Deer
166092	Deer
166093	Deer
166094	Deer
166095	Deer
166096	Deer
166097	Deer
166098	Deer
166099	Deer
166100	Deer
166101	Deer
166102	Deer
166103	Deer
166104	Deer
166105	Deer
166106	Deer
166107	Deer
166108	Deer
166109	Deer
166110	Deer
166111	Deer
166112	Deer
166113	Deer
166114	Deer
166115	Deer
166116	Deer
166117	Deer
166118	Deer
166119	Deer

Genetic Characterization of Harvest and Broom Quality Traits in Broomcorn

Jessica Bubert¹, Patrick Brown¹, Stephen Moose¹

Department of Crop Sciences; University of Illinois; Urbana-Champaign, Urbana, IL, 61801

*Contact: jlbubert2@illinois.edu



Abstract

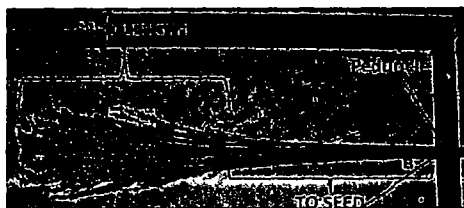
Broomcorn (*Sorghum vulgare* var. *technicum*) is a type of sorghum specifically chosen for its utility in the broom-making industry. Ideally, broomcorn lines have an extended panicle with the seed set congregated at the very end of the panicle. The branches of the panicle would begin at the peduncle with minimal fusing of the central branches. These varieties are well suited for mechanical harvesting, after which the seed is removed and the panicle straw woven into brooms. The pedicels on the end of the straw act to capture dust particles while the thicker portion of the panicle provides support for the broom. Broomcorn improvement at the University of Illinois over the past forty years has relied heavily on field breeding for desired harvest and broom quality traits. Recent advancements in low cost genotyping technologies have enabled gene discovery and molecular breeding in broomcorn. High throughput genotyping of 55 broomcorn cultivars that represent the available phenotypic variation generated high confidence single nucleotide polymorphisms (SNPs). An Fst analysis of these SNPs assessed the genetic differentiation of the broomcorn sorghum types with traditional sweet and grain sorghum lines. Additionally, phenotypes used to assess the "broominess" were collected for several hundred individuals across the 55 populations. These traits include total panicle length, proportion of panicle with seed, yield per panicle, plant height, seed color, and a qualitative measurement of central branch fusion. A genome-wide association study (GWAS) approach was used to identify loci that contribute to the variation observed in the broom quality and agronomic traits. Further assessment of these loci can help to elucidate the genes involved in inflorescence architecture and could aid in the improvement of broomcorn lines through the use of marker assisted selection.

Introduction

Broomcorn varieties are sorghum lines that are specifically chosen for their utility in the broom-making industry. Broomcorn was introduced to the United States in the early 1700's and spread to the northeastern states. Illinois was the number one producer of broomcorn starting in the 1860s with production centered near Arcola, IL. A decade later production had dropped to 100,000 acres nationwide and a majority of broomcorn used for production in the United States is imported from Mexico. Current breeding efforts are focused on germplasm retention, viability of mechanical harvest, and improved broom quality traits for production.

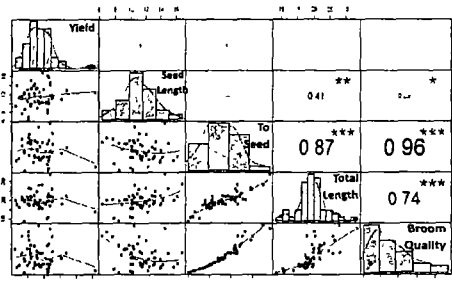
Ideally, broomcorn varieties should have a long panicle with the seeds congregated at the very end of the panicle. The branches of the panicle would begin at the peduncle with minimal fusing of the central branches. These varieties can then be harvested, the seed can be removed, and the panicle straw woven into brooms. The microhairs on the end of the straw, where the seeds were removed, act to capture dust particles and the thicker portion of the panicle provides support for the broom.

A. Phenotyping for broom quality traits



A. Panicle measurements were taken on each panicle in a row prior to threshing. Broomcorn heads have a long peduncle, or upper internode, followed by fibers originating from compressed panicle nodes. These fibers are branched toward the tip and seeds set on the tips of these branches. Length to seed was a measurement of the length of the fibers from the top of the peduncle to the point at which seed set begins (TO SEED). Seed length was the distance from the beginning of seed set to the tip of the panicle (SEED LENGTH). Finally a qualitative measurement of fusion was recorded. If the central fibers of the panicle were fused for 1/4 or more of the length of the panicle from the peduncle, the individual was marked as fused. Yield was measured as the amount of seed in grams obtained from mechanical threshing (Wintersteiger LD350 Laboratory Thresher).

B. Diversity exists for broom traits within broomcorn germplasm



B. [At Left] Diagonal Distributions of each of the five quantitative variables: yield, seed length, length to seed, total length and broom quality with density plots in red. Lower triangle: Scatterplot of paired variables, trendlines in red. Upper triangle: Correlations with significance values. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Analysis of the five continuous variables shows several significant correlations. Since the total panicle length is comprised of the sum of the seed portion and the length to seed, the two significant and positive correlations are expected. Additionally, Broom Quality values are a function of the total length, length to seed, and seed portion so the positive and significant correlations seen between those values are also expected. There are no significant correlations between the linearly independent values of yield, seed portion and length to seed.

(Below) Additionally, phenotypic selection has resulted in the development of broomcorn lines for a variety of purposes.



IL 03
Broom Construction Quality

Black Spanish
Decorative Broomcorn Varieties

Bezra
Decorative Broomcorn Varieties

Japanese Dwarf
High Yielding Sorghum-Like

UI4836
High Yielding Sorghum-Like

Broom Quality Score

A quantitative measure of broom quality

A broom quality (BQ) measurement was calculated by dividing the total length of the panicle (sum of the length to the seed and the seed portion) by the ratio of the seed portion to the length of the panicle to the seed. Higher broom quality values would indicate that the broomcorn panicle would be more ideally suited for broom production.

$$\frac{\text{TO SEED} + \text{SEED LENGTH}}{\text{SEED LENGTH} / \text{TO SEED}}$$

Range = 0 – 79.3

Broomcorn Genotyping

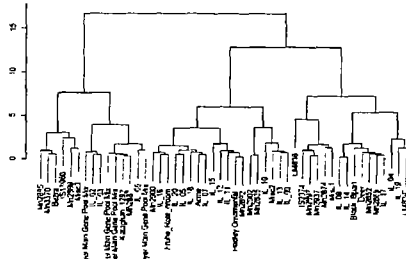
Genotyping By Sequencing

Genotyping-by-sequencing was completed at the University of Illinois on 41 broomcorn populations, resulting in almost 100,000 called single nucleotide polymorphisms.

Filtering steps included removing SNPs that weren't mapped to a chromosome and removing any SNPs with a minor allele frequency less than 0.1. Identical side-by-side SNPs within 64 base pairs were also removed. The remaining 24,238 SNPs were used for genomic analysis.

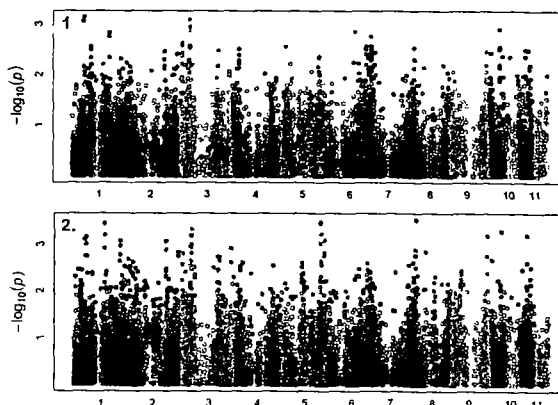
Genetic Characterization of Broom Quality Traits

A. K-means Clustering



A. Hierarchical clustering of x-scores using a Euclidean distance matrix and Ward's Clustering. Initially assigned groupings shown by branch color: Poor (blue), Good (green), Excellent (red). The excellent lines cluster together. A group of the poor lines cluster together as well. The remaining good and poor lines are mingled across the remaining clusters.

B. Genome Wide Association Studies for Broom Quality Traits



B. Genome wide association study of broom quality traits in broomcorn germplasm showed no SNPs with highly significant associations with total panicle length (B1) or broom quality score (B2). GWAS was performed using a compressed mixed linear model implemented in GAPIT using an EMMA derived kinship matrix. The lack of significant associations may be due to the small population sample size, especially those population showing high broom quality scores. Phenotypic data from additional years may also help elucidate significant SNP associations.

Future Work

Fst analysis will indicate the level of relatedness between the sorghum lines and the broom-type lines.

Analysis to date only includes data from the 2013 growing season. Additional phenotypic data is being analyzed for 2014 and collected for 2015 with more traits included in the evaluation.

Crosses between broom type lines and grain sorghum will create segregating populations on which further genetic characterization can take place.

Acknowledgements

We thank The Monahan Broomcorn Trust for funding the broomcorn project.

Additionally we thank The Brown lab members for their work on genotyping the broomcorn populations and the Moose lab members for aiding in planting, pollinating, harvesting, and threshing the broomcorn population.

Finally, we thank Dr. Henry H. Hadley for his contribution of over 40 years of broomcorn research and germplasm collection.

Subject: Re: Nolan Broomcorn Trust meeting

From: Moyerbase (moyerbase@aol.com)

To: smoose@illinois.edu; pjb34@illinois.edu; tim_monahan@thomasmonahan.com; swaun@att.net; tammy.mbmlaw@gmail.com; bart@pelray.com;

Date: Friday, November 18, 2016 8:18 PM

2016 Broomcorn Report-Nolan Trust by Sam Moyer, Ph.D.

The big news: Bart Pelton <http://www.pelray.com/> in July requested broomcorn seed for a risky late plant in Torreon, Mexico for harvest late Oct. Sent "main gene pool mix". Photos showed it growing well, but a sample not sprayed for aphids was devastated. Am interested if crooks and tillers were less problem with less rain. I will receive a sample of this crop in March.

Sent more "gene pool" seed for a December planting in Southern Mexico and more for a March plant in Torreon. Included a samples of "Dark Green" variety, isolated from the gene pool. Asking his opinion of a slight defect where individual fibers have minute branches. But it has few crooks or tillers.

My 5/24 planting of "gene pool" had excessive rain but too many crooks and tillers.

An estimated 1/4 acre produced:

26+" 24" 22" 20" 18" 16" 14" 12" 10"
4 lbs 14 26 29 32 26 9 5 3 = 148 lbs

Pieces/lb (2 observations)

- 21,23; 27,27; 33,34; 37,39 - -

Lengths shorter than 16" are probably tillers. Brush colors were not as good as usual (due to no rain last month, plants dying rapidly?)

There were a few 12' plants, outcrosses from different genes in the pool(?)

My 6/13 planting had no rain for two weeks, poor sprouting/wide spacing, but produced graceful curved brush about waist high and good brush colors.

This broomcorn probably qualifies as "full tip": most fibers/panicles end near the tip; not many "whiskers". It can be cut by machine: most plants have long peduncles and not much of the top "boot" covers brush. Boots pull off easy after drying, not many brushes have a stain from slow drying.

Continue to develop/maintain 3 ornamental varieties:

Hadley's ornamental, many types (beautiful!)

Dwarf Mayo decorative/beautiful seed covers(glumes)

Aqua brush

Continue to select 5 varieties for shorter brush; whisk/insides (no "sticks"!)

Selected some third generation plants from crosses of

Hadley dwarf Deer x Hadley "shatter" (non-shattering plants/fungus affected)

This might qualify as "Improved Deer" after selecting another year. Might be "EZ snap" Will need fungus challenge.

No trust funds were expended for this work.