

## Performance and release of new *Striga* tolerant/resistant sorghum varieties

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**Background:** One of the major components of the *Striga* project management has been to evaluate *Striga* tolerant or resistant sorghum lines. Studies were undertaken on-station and, on infested farmers fields in the Central, Eastern and Lake Zones. Out of this study two sorghum varieties have been approved and released by the Tanzania National Seed release Committee. Both cultivars were developed at Purdue University in the USA. Sorghum cultivar P9405 has been registered with the name Hakika (“sure of getting a crop”) while P9406 has been named Wahi (“early”). Both varieties show good resistance against *S. asiatica*, *S. hermonthica* and *S. forbesii* the most economic important *Striga* species in the country. In addition they are early maturing, drought tolerant, good grain quality and good taste as evaluated by participating farmers.

**Methodology:** Sorghum lines P9405 and P9406 (obtained from Purdue University in the USA), SRN 39 (from Sudan), commercially released cultivars Pato, Macia and local sorghum land race Weijita (from Mara North West of Tanzania) were evaluated for *Striga* resistance at *S. hermonthica*, *S. asiatica* and *S. forbesii* hot spots. Some of the sites were infested by two parasite species. The same materials were also evaluated on farmer’s fields for *Striga* resistance, yield and farmers acceptance. Locations for on-station testing were Melela in Morogoro rural, a hot spot for *S. asiatica* and *S. forbesii*, Hombolo in Central Zone for *S. asiatica* and Ukiriguru in the Lake zone where the major problem is *S. hermonthica*. The entries were planted in plots of four rows replicated three times. *Striga* counts were from two center rows at 9<sup>th</sup> and 12<sup>th</sup> week after planting (WAP) and at harvest. Sorghum grain yield was assessed from the two center rows

The on-farm evaluation was conducted at three villages in Dodoma rural (Mvumi Makulu, Mpalanga and Chipanga) and two villages in Misungwi (Mwagalla and Iteja) districts. From each village at least five farmers participated in the trials. On-farm plot sizes were 5 m by 10 m with farm sites used as a replicate. *Striga* counts and sorghum grain yields were determined from the five middle rows at 12<sup>th</sup> week after planting (WAP). Group discussion and matrix ranking was undertaken to determine farmer preferences and acceptability of the new materials.

**Results:** The evaluations were undertaken over a three year period and typical results are shown for replicated field trials in Tables 1-7. It was consistently observed that lines P9405 and P9406 supported lower numbers of emerged *S. asiatica*, *S. forbesii* and *S. hermonthica* than other lines, particularly the released cultivar Pato. The “P” lines also tended to be more productive, producing higher yield than Pato and Macia at heavily infested sites. Pato and Macia on the other hand have a higher yield potential and perform well under *Striga* free conditions, as was observed at Ilonga (Table 7). These observations were confirmed under farmer management across a range of soil types in villages in both the Lake and Central Zones (Tables 8-14). Farmers ranked the sorghums under test on their fields over two seasons according to their own criteria. Examples of these perceptions are shown in Tables 16 and 17. P9405 and P9406 ranked highly for a number of important traits including drought and *Striga* tolerance, early maturity and yield. Infestation levels of a number of diseases were also recorded. P9405, P9405 and Macia are not susceptible to leaf blight that was a particular problem on Pato at a number of locations in 2002. P9406 is

somewhat more susceptible than other lines to long smut so it would be better to plant P9405 at on *Striga* infested fields in areas where long smut is common.

**Conclusion:** Many farmers have adopted Pato due to its high yielding and relatively early maturity. However under conditions of drought, *Striga* and foliar disease, the productive potential of Pato is not realised. In such situations P9405 and P9406 offer alternative options and have been ranked by farmers as early maturing, *Striga* and drought resistant. Some local cultivars, although highly palatable, are late maturing and low yielding. Farmer assessment indicates that P9405 and P9406 are palatable and have a potential to be marketed. As a result of this work the findings were presented to the Tanzania Official Seed Certification Agency who agreed to the registration and release of P9405 as the cultivar “Hakika” (meaning to be sure) and P9406 as Wahi (meaning early). Foundation seed is now under multiplication. The main characteristics of each cultivar are summarised in the attached fact sheet “

**Table 1: Evaluation of advanced sorghum lines for *Striga* resistance and sorghum grain yield, Melela Morogoro 2000**

Sorghum Entries	<i>Striga</i> numbers/7.5 m <sup>2</sup>				Yield (t/ha)
	9 WAP		12 WAP		
	<i>S. forbesii</i>	<i>S. asiatica</i>	<i>S. forbesii</i>	<i>S. asiatica</i>	
<b>P9405</b>	0.8	1.0	3.5	21.3	1.7
<b>P9406</b>	0.0	0.5	8.0	16.8	2.0
SRN 39	3.3	7.0	55.5	114.0	1.6
Weijita	0.5	4.0	29.5	117.3	1.6
<b>Pato</b>	0.3	10.5	17.5	190.0	1.2
Macia	0.8	11.5	29.8	216.8	1.1
Mean	0.92	5.75	23.96	112.67	1.53
SE	0.40	1.58	5.90	28.28	0.09

**Table 2: Evaluation of advanced sorghum lines for *S. asiatica* resistance and grain yield, Hombolo, 2000:**

Sorghum Entries	Striga Numbers/7.5m <sup>2</sup>			50 % flowering	Plant height (cm)	Yield kg/ha
	9WAP	12WAP	harvest			
P9405	7.0	42.3	99.5	69	97	1013.3
P9406	8.8	78.0	127.0	71	83	566.7
<b>SRN 39</b>	15.0	156.5	235.0	69	108	340.0
Weijita	4.8	56.0	98.5	70	182	420.0
Pato	8.8	125.5	161.8	71	116	526.7
Macia	7.8	104.5	149.5	70	95	846.7
G.Mean	8.83	93.79	145.21	70	107.3	618.93

SE	1.89	16.08	18.18	0.21	6.50	108.40
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**Table 3: Evaluation of sorghum cultivars for *S. asiatica* resistance, Hombolo 2002**

Sorghum entries	Plant stand	STRIGA COUNT			Plant height(cm)	Yield (t/ha)
		9WAP	12WAP	At harvest		
P9405	78	17	18	25	106	2.0
P9406	90	14	23	41	95	1.6
SRN 39	90	38	150	169	141	0.8
Weijita	93	23	125	141	171	0.7
Pato	88	28	93	105	137	0.9
Macia	90	12	58	71	108	1.1
Mean	88.4	22.0	77.8	92.0	126.3	1.20
S.E.	2.7	3.6	14.8	15.2	5.9	0.15

**Table 4: Evaluation of advanced sorghum lines for Striga resistance and grain yield, Ukiriguru 2000**

Sorghum Entries	Striga numbers/7.5m <sup>2</sup>						Yield Kg/ha
	S. herm. 9WAP	<i>S. asia</i> 9WAP	S. herm. 12WAP	<i>S. asia</i> 12WAP	S. herm. harvest	<i>S. asia</i> harvest	
P9405	12.8	0.8	32.0	13.8	42.8	26.8	783
P9406	2.3	0.0	11.5	21.3	9.8	27.0	583
<i>SRN 39</i>	4.8	0.0	59.0	7.5	77.5	9.8	87
Weijita	7.8	0.0	74.8	8.3	122.0	8.3	60
Pato	5.5	0.0	40.0	15.5	62.3	14.3	233
Macia	9.0	0.0	45.5	3.5	60.0	6.3	283
Mean	7.00	0.21	43.79	11.63	62.38	15.38	338.3
S.E.	1.09	0.15	6.44	3.54	11.11	5.17	58.65

NB S. herm. = *Striga hermonthica* *S. asia* = *S. asiatica*

The season was poor with terminal drought; heavy infestation by midge resulted in low sorghum grain yields

**Table 5: Evaluation of sorghum cultivars for *S. hermonthica* resistance, Ukiriguru, 2002**

Sorghum entries	Plant stand	STRIGA COUNT			Days to 50% flower	Leaf blight score(1-5)	Yield (kg/ha)
		9WAP	12WAP	At harvest			
P9405	76	0.0	4.7	47.3	67	1.0	933
P9406	72	1.0	5.5	14.0	66	1.0	943
SRN 39	66	0.0	7.3	48.0	80	1.3	890
Weijita	72	0.3	2.3	19.5	83	1.3	953
Pato	67	0.0	3.5	9.0	84	1.5	823
Macia	69	0.8	8.3	35.0	75	1.0	963
G. Mean	70.0	0.35	5.26	28.45	76.2	1.17	917
S.E.	1.3	0.18	1.09	7.60	1.8	0.08	55.3

**Table 6: Evaluation of advanced sorghum lines for grain yield, on a *Striga* free field plot, Ilonga 2000**

Sorghum Entries	Stand count	50% flowering	Plant height (cm)	Number of lodged plants	Agronomic score (1-5)	Grain yield (t/ha)
P9405	57	58	105	0	2.1	2.3
P9406	61	58	107	0	3.1	1.8*
SRN 39	53	62	131	3	2.6	2.2
Weijita	63	65	204	1	3.4	3.3
Pato	56	63	151	1	3.0	3.2
Macia	49	62	104	3	2.9	2.1
G.Mean	56.3	61.5	133.5	1.8	2.84	2.46
SE	1.7	0.6	7.8	0.4	0.12	0.14

\*Damage by American boll-worm at grain filling

**Table 7: Evaluation of sorghum genotypes for *S. asiatica* resistance and grain yield, Mpalanga 2001**

Entry Name	Plant stand count	<i>Striga</i> count/25m <sup>2</sup>		Yield (t/ha)
		12 WAP	At harvest	
P9405	200	10.0a	72.8a	1.4c
P9406	190	286.4a	500.5ab	1.1b
SRN 39	171	275.6a	473.6ab	1.2bc
MACIA	181	134.1a	578.4b	1.1b
PATO	184	648.2b	1533.8d	0.6a
<i>G.Mean</i>	2185.6	270.85	631.83	1.05
SE	6.2	51.39	93.85	0.05

**Table 8: On-farm evaluation of promising sorghum genotypes for *S. asiatica* resistance and grain yield, Chipanga 2001**

Entry Name	Stand count/ 25m <sup>2</sup>	<i>Striga</i> count/25m <sup>2</sup>		Long smut 25 m <sup>2</sup>	Yield t/ha
		12 WAP	<i>At harvest</i>		
P9405	189	0.0	0.0	1.5a	1.6
P9406	191	0.0	0.0	14.4c	1.0
SRN 39	230	0.0	0.8	4.3ab	1.6
Macia	226	0.0	16.0	10.9bc	1.4
Pato	185	46.3	99.7	11.8bc	1.5
<i>Mean</i>	204.3	9.27	23.28	8.57	1.42
S.E.	8.4	7.99	15.30	1.41	0.11

**Table 9: On-farm evaluation of promising sorghum genotypes for *Striga* resistance and grain yield, Chipanga 2001**

Entry Name	Stand count/ 25 m <sup>2</sup>	<i>Striga asiatica</i> count/25m <sup>2</sup>		Yield t/ha
		12 WAP	<i>At harvest</i>	
P9405	115	1.6a	4.4a	1.0
P9406	117	2.3a	4.6a	0.9
Pato	127	55.8b	109.8b	0.7
Mean	120.4	19.89	39.61	0.87
S.E.	5.5	7.5	12.31	0.07

Table 10: On-farm evaluation of promising sorghum genotypes for Striga resistance and grain yield, Mwagalla 2001

Entry Name	Stand count/ 25 m <sup>2</sup>	<i>S. hermonthica</i> count/25m <sup>2</sup>		Yield kg/ha
		12WAP	At harvest	
P9405	38	11.5	18.2	252
P9406	38	11.2	13.8	372
SRN 39	27	21.8	40.9	228
Weijita	27	29.0	47.1	452
Macia	25	9.6	7.5	239
Pato	39	29.1	40.8	350
Mwa'ndungu	10	14.2	20.0	600
Mean	31.9	18.3	27.29	321.0
S.E.	2.1	3.5	4.59	0.04

Table 11: On-farm evaluation of promising sorghum genotypes for *S. asiatica* resistance and grain yield, on Isang'a Chitope soils, Mvumi 2002

Entry Name	Plant count/25m <sup>2</sup>	STRIGA COUNT/25m <sup>2</sup>		Yield t/ha
		12WAP	At harvest	
P9405	116	18.0	143.7	2.0b
P9406	125	13.7	20.5	1.4ab
Macia	128	265.3	276.8	1.1ab
Pato	134	301.0	776.8	0.8a
G.Mean	125.6	149.50	304.46	1.31
S.E.	11.4	68.41	163.88	0.96

Table 12: On-farm evaluation of promising sorghum genotypes for *S. asiatica* resistance and grain yield, on Ngongomba soils, Chipanga village - 2002:

Entry Name	Plant count/25m <sup>2</sup>	STRIGA COUNT/25m <sup>2</sup>			Yield t/ha
		9WAP	12WAP	Harvest	
P9405	98	0	0	0	1.0
P9406	104	0	0	0	1.4
Macia	111	0	0	0	1.6
Pato	88	0	0	1.4	1.4
G.Mean	100.3	0	0	1.03	1.34
S.E.	6.0	0	-	-	0.16

**Table 13: On-farm evaluation of promising sorghum genotypes for *S. hermonthica* resistance and grain yield, at Luseni soils, Iteja 2002:**

Entry Name	Plant count/25m <sup>2</sup>	STRIGA COUNT/25m <sup>2</sup>			Yield t/ha
		9WAP	12WAP	Harvest	
P9405	44	3.8	11.2	14.2	1.2
P9406	43	6.2	18.6	24.4	1.2
Macia	42	5.8	15.0	19.8	0.8
Pato	45	9.4	45.4	89.8	1.1
G.Mean	43.4	6.30	22.55	37.05	1.06
S.E.	3.4	1.52	6.43	15.54	0.12

**Table 14: On-farm evaluation of sorghum genotypes for *S. hermonthica* resistance and grain yield, Mwangalla 2002**

Entry Name	Plant stand count	STRIGA COUNT/25m <sup>2</sup>			Yield kg/ha
		9WAP	12WAP	At harvest	
Pato	128	35.8	196.0b	192.0b	337
P9406	100	5.2	16.7a	27.3a	783
P9405	97	11.5	36.8ab	56.8a	603
Macia	73	5.3	69.7ab	69.8a	437
G. Mean	99.6	14.46	79.79	86.50	540.0
S.E.	10.8	5.27	29.94	23.19	124.0

**Table 15: Disease score (scale 1-5) from sorghum cultivars tested on farm Dodoma rural 2002:**

Sorghum entries	Leaf blight	Sooty stripe	Long smut
<b>P9405</b>	<b>1.5</b>	<b>1.4</b>	<b>1.4</b>
<b>P9406</b>	<b>1.5</b>	<b>1.3</b>	<b>1.8</b>
Macia	1.5	1.6	1.5
<b>Pato</b>	<b>3.0</b>	<b>1.0</b>	<b>1.6</b>
<b>G.Mean</b>	<b>1.83</b>	<b>1.31</b>	<b>1.57</b>
<b>S.E.</b>	<b>0.12</b>	<b>0.07</b>	<b>0.14</b>



**Table 16: Sorghum variety preference by farmers criteria: men and women in Mvumi Makulu village Dodoma rural:**

	Criteria	Tege meo	Mhuputa	Sandala	Pato	Lugugu	P9406	P9405	Bangala	Lugugu Arusha
1	High yielding	4	8	5	<b>1</b>	9	<b>2</b>	<b>3</b>	7	6
2	Ability to withstand drought	4	7	5	<b>3</b>	9	<b>1</b>	<b>1</b>	8	6
3	Ability to withstand Striga	4	9	5	<b>3</b>	8	<b>2</b>	<b>1</b>	7	6
4	Shortness of plants	3	7	5	4	9	<b>2</b>	<b>1</b>	8	6
5	Ease of marketing	9	6	3	<b>5</b>	1	6	5	4	2
6	Resistance to birds	6	-	5	7	2	8	9	1	4
7	Not easily attacked by field pests	6	3	5	9	1	7	8	3	4
8	Not shattering	4	2	5	3	8	2	1	7	6
9	Resistance to storage pests	9	9	6	5	1	7	8	4	3
10	Good tasting of ugali	9	2	7	8	1	6	5	4	2
	Total	58	56	51	48	49	43	42	53	45
	<b>Ranking according to criteria</b>	<b>9</b>	<b>8</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>7</b>

**Table 17: Sorghum variety ranking by farmers criteria: Women in Iteja village Missungwi district.**

No	Criteria	Pato	Weijita	P9406	P9405	Macia	SRN 39	Mwnangund -ungu	Tegemeo	Mbapa- saba
1	Ability to withstand drought	7	9	3						
2	High yielding	4	6	3	2	1	4	5	6	8
3	Early maturing	5	9	3	2	1	4	8	6	7
4	Ability to withstand Striga	5	9	3	2	1	4	6	7	8
5	Diseases/pest tolerance	7	9	3	2	1	4	6	5	8
6	Easy of dehulling	1	3	-	-	-	3	3	2	3
7	Good taste	3	7	5	2	1	6	8	4	9
8	Marketability	1	8	5	4	3	9	6	2	7
9	Whiteness of grain	3	9	5	4	2	6	7	1	8
10	Ease of threshing	1	2	6	5	3	9	8	4	6
	Total	37	71	36	23	13	49	57	37	64
	<b>Ranking</b>	<b>4</b>	<b>9</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>6</b>	<b>7</b>	<b>4</b>	<b>8</b>

## MBEGU MPYA ZA MTAMA ZENYE UKINZANI DHIDI YA VIDUHA: “HAKIKA NA WAHI”<sup>2</sup>



Mbegu aina ya **Hakika**



Mbegu aina ya **Wahi**

Aina mbili za mtama Hakika na Wahi zimezalishwa na Kituo cha Utafiti wa Kilimo Ilonga kwa ajili ya kuoteshwa kwenye mashamba yaliyoathirika na viduha. Hizi mbegu zimepewa majina ya Hakika maana yake upo uhakika wa kuvuna kwenye shamba lililoathiriwa na viduha na Wahi inamaanisha kuwahi kukomaa.

### **Sifa za mitama hii ni:**

- ◆ Huvumilia viduha
- ◆ Huvumilia ukame
- ◆ Hukomaa mapema

Mbegu hizi zina rangi ya manjano iliyopauka. Aina zote mbili za mbegu hizi zinafaa sana kwa kupika ugali. Hii inatokana na tathmini iliyofanywa na wakulima wa wilaya za Dodoma vijijini na Misungwi na kuonyesha ubora ulio sawa na mitama mingi ya kienyeji.

Wakulima wengi wa sehemu kame za Tanzania, wanaolima mitama ya aina mbalimbali hushuhudia mazao yao yakidumaa kwa sababu ya ukame na hatimaye kutoa mavuno madogo sana, pia hali hii husababishwa na mashambulizi yanayotokana na viduha kutoka kwenye mashamba yaliyoathirika na viduha.

*Kwa nini viduha ni tatizo katika zao la mtama ?*

- ◆ Mimea ya viduha, ni tegemezi kwa sababu hujishikiza kwenye mizizi ya mtama kwa kutumia mizizi yake na kupata chakula, na maji kutoka kwenye mtama Viduha pia hushambulia mazao mengineya nafaka kama mahindi na mpunga. Viduha haviwezi kuota bila kuwepo zao la nafaka.
- ◆ Mimea iliyoshambuliwa na viduha , hudumaa na kudhoofika kwa ukame kwa sababu hupoteza chakula na maji ambavyo huchukuliwa na viduha.
- ◆ Mashambulizi ya viduha ni tatizo mojawapo kwenye mashamba yanayozalishwa mazaoya nafaka mara kwa mara, yenye udongo wa asili ya kichanga ambao wakulima kwa nadra sana

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<sup>2</sup> Fact sheet describing the characteristics of cultivars Hakika and Wahi.

hutumia samadi au mbolea ya chumvichumvi. Hii inatokana na ukweli kuwa viduha hustawi vyema kwenye udongo wenye rutuba duni ambao hushindwa kustawisha vyema mtama.

- ◆ Mitama mingi ya kienyeji na iliyotolewa kwa wakulima hapo awali ikiwemo Pato na Tegemeo, hushindwa kukua na kuzaa vizuri katika mashamba yaliyoshambuliwa na viduha.

*Kwa nini tulime Hakika na Wahi ?*

Baada ya kufanyiwa utafiti katika wilaya za Dodoma mjini, Dodoma vijijini na Misungwi kwa misimu sita, mtama wa aina ya Hakika na Wahi imeonyesha kutoa mavuno bora na mengi katika maeneo yaliyoshambuliwa na viduha. Aina hizi za mtama hukua haraka licha ya mashambulizi ya viduha, na huzaa vizuri zaidi ya aina nyingine za mtama.

*Visifa vya Mbegu ya Hakika na Wahi*

<i>Sifa</i>	<i>Hakika</i>	<i>Wahi</i>
Urefu wa mmea	Mita 1.4 hadi 1.6	Mita 1.3 hadi 1.4
Muda wa kutoa maua tangu kupanda	Siku 58 hadi 60	Siku 57 hadi 58
Muda wa kuvuna tangu kupanda	Siku 107	Siku 100
Rangi ya punje	Manjano iliyopauka	Manjano iliyopauka
Shina	Jembamba	Nene
Majani	Membamba	mapana
Idadi ya mavuno penye viduha	Tani 1.0 –2.0 kwa ha	Tani 2.0-2.5 kwa ha
Idadi ya mavuno pasipo viduha	Tani 1.5 – 2.5 kwa ha	Tani 2.5-3.0 kwa ha

**Aina zote mbili za mtama zina:**

- ◆ Ukinzani kwa ugonjwa wa mabaka ya majani (leaf blight)
- ◆ Zinastahimili ukame
- ◆

*Ushauri wa jinsi ya kupanda*

- ◆ Aina hizi ni nzuri kupanda wakati wa mvua za vuli kwenye maeneo yenye misimu miwili ya mvua kama Kanda ya Ziwa na miezi ya Januari na Februari kwenye maeneo yaliyobakia yakiwemo ya Kanda ya Kati.
- ◆ Ili kukwepa kushambuliwa na ndege, inashauriwa kutopanda wakati wa mvua za kwanza.
- ◆ Maeneo ya Kanda ya Ziwa wanashauriwa kutopanda wakati wa mvua za masika ili kukwepa uharibifu unaoweza kutokana na mtama kukomaa wakati mvua zinaendelea kunyesha.
- ◆ Inashauriwa kupanda Hakika kwenye mashamba yenye rutuba haba na sehemu ambazo samadi haipatikani.
- ◆ Panda mbegu kati ya kilo 4 hadi 6 katika hekari moja.
- ◆ Wakati wa kupanda, weka ¼ kilo ya samadi kwenye kila shimo

*Kuchagua mbegu kwa ajili ya kupanda msimu unaofuata:*

- ◆ Chagua mbegu toka shambani masuke safi, makubwa na yaliyokomaa vizuri.
- ◆ Epuka kuchagua suke lililoshambuliwa na ugonjwa wa fugwe
- ◆ Chagua mbegu toka kwenye masuke yaliyo katikati ya shamba ili kupata aina bora ya mbegu ambayo haijachanganyika.