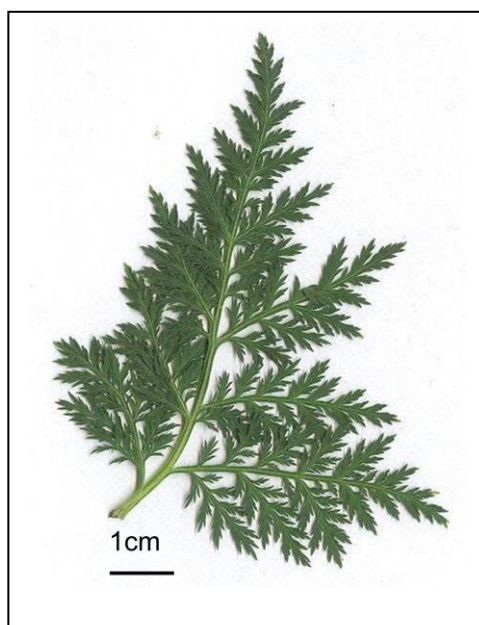




Hyb8001r

An *Artemisia annua* F1 hybrid



Hyb8001r was selected as our commercial hybrid because it is an excellent seed producer and its seedlings establish quickly in the field. The fully grown crop has high biomass and good artemisinin content. This variety is generally suited to most growing environments.

Hyb8001r was trialled at thirteen independent sites in China, India, Madagascar and Uganda; data for artemisinin concentration, dry leaf weight and yield was obtained from each site. The maximum concentration observed was 1.44% (Madagascar), maximum leaf dry weight 4488 kg/ha (China) and maximum artemisinin yield obtained 54.5 kg/ha (Madagascar).

Independent studies validate the performance of this hybrid.

Hyb8001r is registered in China: 药客佳蒿1号.

Results from intermediate field trials

Field trials were conducted at the locations described. Artemis (a hybrid variety of *A. annua*) and a 'local check' (L. Check) were used to compare Hyb8001r's field performance. The local check variety was usually supplied by local growers and was the best variety they had available at the time.

Artemisinin yield (concentration x biomass)

Location	Harvest	Artemisinin Yield (kg/ha)		
		Hyb8001r	Artemis	L. Check
GaoFeng, China	Aug-11	46.9*	37.6	44.0
HongAn, China	Aug-11	37.8	31.8	39.9
Bangalore, India	Apr-11	17.3	12.1	15.1
Ratlam, India	Apr-11	23.5	-	19.7
Antsirabe, Madagascar	Aug-11	24.5	21.6	19.8
Faharepana, Madagascar	Sep-11	41.9***	29.8	32.1
Faharepana, Madagascar	Oct-11	38.1*	28.6	32.4
Kibale, Uganda	Jul-11	35.2**	30.1	22.8
Kibale, Uganda	Jul-11	21.1**	16.8	15.3

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Artemisinin concentration

Location	Harvest	Artemisinin concentration (% leaf dry weight)		
		Hyb8001r	Artemis	L. Check
GaoFeng, China	Aug-11	1.10*	1.00	1.09
HongAn, China	Aug-11	1.08	0.96	1.06
Bangalore, India	Apr-11	1.10*	0.91	1.01
Ratlam, India	Apr-11	1.00**	-	0.84
Antsirabe, Madagascar	Aug-11	1.07	1.00	1.00
Faharepana, Madagascar	Sep-11	1.44***	1.15	1.25
Faharepana, Madagascar	Oct-11	1.17	1.11	1.24
Kibale, Uganda	Jul-11	1.24**	1.04	1.05
Kibale, Uganda	Jul-11	0.98***	0.83	0.82

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Biomass

Location	Harvest	Leaf dry weight (kg/ha)		
		Hyb8001r	Artemis	L. Check
GaoFeng, China	Aug-11	4488	4050	4239
HongAn, China	Aug-11	4150*	3357	4036
Bangalore, India	Apr-11	1785	1417	1555
Ratlam, India	Apr-11	2731	-	2559
Antsirabe, Madagascar	Aug-11	2398	2270	2035
Faharepana, Madagascar	Sep-11	3226*	2634	2723
Faharepana, Madagascar	Oct-11	3532***	2348	2394
Kibale, Uganda	Jul-11	2948	2912	2291
Kibale, Uganda	Jul-11	2257	2086	2062

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Height

Location	Harvest	Height at harvest (cm)		
		Hyb8001r	Artemis	L. Check
GaoFeng, China	Aug-11	221*	197	229
HongAn, China	Aug-11	226*	200	227
Bangalore, India	Apr-11	167	151	156
Ratlam, India	Apr-11	192**	-	153
Antsirabe, Madagascar	Aug-11	180***	156	146
Faharepana, Madagascar	Sep-11	194***	166	163
Faharepana, Madagascar	Oct-11	193***	159	149
Kibale, Uganda	Jul-11	207*	174	207
Kibale, Uganda	Jul-11	168	142	158

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Results from advanced field trials

Artemisinin yield (concentration x biomass)

Location	Harvest	Artemisinin Yield (kg/ha)		
		Hyb8001r	Artemis	L. Check
Antsirabe, Madagascar	Sep-11	17.1***	9.7	12.8
Antananarivo, Madagascar	Sep-11	54.5*	43.6	47.6
Kiizi, Uganda	Aug-11	20.9	16.7	18.6
Mparo, Uganda	Aug-11	20.7	22.5	21.0

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Artemisinin concentration

Location	Harvest	Artemisinin concentration (% leaf dry weight)		
		Hyb8001r	Artemis	L. Check
Antsirabe, Madagascar	Sep-11	1.07***	0.89	0.97
Antananarivo, Madagascar	Sep-11	1.34*	1.22	1.34
Kiizi, Uganda	Aug-11	1.02***	0.84	0.88
Mparo, Uganda	Aug-11	1.08*	0.84	1.01

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Biomass

Location	Harvest	Leaf dry weight (kg/ha)		
		Hyb8001r	Artemis	L. Check
Antsirabe, Madagascar	Sep-11	1630*	1125	1318
Antananarivo, Madagascar	Sep-11	3994	3900	3805
Kiizi, Uganda	Aug-11	2046	2000	2218
Mparo, Uganda	Aug-11	2249	2466	2198

* - significant over Artemis ($p < 0.05$), ** - significant over Local Check ($p < 0.05$)

Height

Location	Harvest	Height at harvest (cm)		
		Hyb8001r	Artemis	L. Check
Antsirabe, Madagascar	Sep-11	159***	124	126
Antananarivo, Madagascar	Sep-11	228*	206	224
Kiizi, Uganda	Aug-11	226*	177	225
Mparo, Uganda	Aug-11	215***	161	182

* - significant over Artemis (p<0.05), ** - significant over Local Check (p<0.05)

Further, independent studies on Hyb8001r

In 2016, Suberu *et al.*, published data from their studies on 13 different varieties of *Artemisia annua* field grown in Madagascar. The results indicated that Hyb8001r was the best performing hybrid: 'overall CNAP8001 had the best profile for the metabolites analysed'.

This research was carried out entirely independently of the CNAP Artemisia Research Project.

Suberu, J., Gromski, P.S., Nordon, A., Lapkin, A. (2016). Multivariate data analysis and metabolic profiling of artemisinin and related compounds in high yielding varieties of *Artemisia annua* field-grown in Madagascar. *Journal of Pharmaceutical and Biomedical Analysis* **117**, 522-531/

Metabolite profile summary for hyb8001r

Metabolite profile data for hyb8001r was obtained from thirteen sites; five in Madagascar, four in Uganda, two in China, and two in India.

MassTag ¹	Metabolite ID ²	Platform	Hyb percent ³	Hyb Fold-change ⁴	Hyb range ⁵	Artemis percent ³	Artemis range ⁵	L. Check percent ³	L. Check range ⁵	Range Overlap ⁶
M283.1570T61	artemisinin	UPLC	24.0	1.3	23-25	27	22-31	28	26-31	Y
M235.1717T71	dihydroepideoxyarteannuin B	UPLC	9.3	26.0	8.2-9.8	8.4	7.5-9.8	9.8	7.6-11	Y
M375.1075T57	casticin	UPLC	6.1	27.0	5.7-6.9	6.1	5.1-8.1	5.1	3.7-7	Y
M191T592	prodox	GC	4.2	4.6	3.8-4.6	1.9	0-13	2.1	0-11	Y
M267.1594T63	deoxyartemisinin	UPLC	3.2	51.0	2.9-3.5	3.8	2.5-5.8	4.3	3.1-5.5	Y
M621.3114T104	unknown	UPLC	2.5	220.0	2.4-2.6	1.3	0.011-2.5	1.9	1.1-2.4	Y
M41T382	B-pinene	GC	2.5	5.3	1.4-4.5	0.49	0-1	1.5	0-9.8	Y
M251.1644T56	unknown	UPLC	2.4	1.5	2.3-2.5	1.9	1.9-2	2.2	2.2-2.2	N
M251.1637T51	unknown	UPLC	2.2	1.4	1.3-3.2	2.3	1.1-4.2	2.7	1.6-3.9	Y
M269.1744T55	unknown	UPLC	2.2	41	1.9-2.5	1.9	1.8-2.1	1.8	1.8-1.8	Y
M269.1755T53	unknown	UPLC	2	1.3	1.5-2.5	1.9	1.4-2.3	2.2	1.9-2.5	Y
M233.1537T52	unknown	UPLC	1.3	16	1-1.4	1.1	0.92-1.2	1.2	1.1-1.3	Y
M237.1482T44	unknown	UPLC	1.1	56	0.94-1.2	0.84	0.76-1	0.84	0.84-0.84	Y
M225.1482T61	unknown	UPLC	1.1	1.5	0.96-1.2	0.87	0.64-1.1	NA	NA-NA	Y
M249.1503T50	arteannuin B	UPLC	1	14	0.87-1.4	0.47	0.3-0.61	0.42	0.36-0.46	N
M283.1927T81	unknown	UPLC	1	1.5	0.92-1.2	0.88	0.68-1.1	1	0.86-1.2	Y
M193.0493T24	scopoletin (putative)	UPLC	0.97	36	0.66-1.8	0.88	0.24-1.5	0.8	0.25-1.5	Y
M237.1873T82	dihydroartemisinic acid	UPLC	0.95	28	0.72-1.2	0.94	0.66-1.3	1.3	0.7-1.7	Y
M53T457	pinocarvone	GC	0.95	2.5	0.68-1.4	0.38	0.12-0.57	0.33	0.091-0.65	N
M387.1829T57	unknown	UPLC	0.92	67	0.74-1.1	0.6	0.17-1.3	0.64	0.18-1.2	Y
M251.1650T81	unknown	UPLC	0.9	1.4	0.53-1.1	0.62	0.23-0.98	0.56	0.23-0.92	Y
M235.1688T83	artemisinic acid	UPLC	0.88	12	0.59-1.1	0.54	0.35-0.73	0.6	0.41-0.72	Y
M269.1755T42	unknown	UPLC	0.88	1.4	0.72-1	0.72	0.53-0.82	0.83	0.72-0.94	Y
M183.0649T38	2,4-dihydroxy-6-methoxy acetophenone (putative)	UPLC	0.83	15	0.6-0.97	1.1	0.37-1.5	0.51	0.24-0.8	Y
M203.1789T82	unknown	UPLC	0.82	1.4	0.65-0.98	0.65	0.056-1.7	0.53	0.05-1.4	Y
M359.1128T70	retusin (putative)	UPLC	0.81	19	0.58-1.1	0.56	0.24-0.81	0.67	0.4-1.5	Y
M361.0915T49	chrysoplennol C (putative)	UPLC	0.81	3.4	0.57-1.2	1.4	0.68-2.5	0.52	0.27-1	Y
M219.1736T83	artemisinic aldehyde (putative)	UPLC	0.67	9.3	0.51-1.1	0.44	0.0064-0.7	0.46	0.05-0.87	Y
M355.1047T13	scopolin (putative)	UPLC	0.66	-0.05	0.57-0.76	0.71	0.25-1.1	0.6	0.24-1	Y
M637.3057T93	unknown	UPLC	0.65	82	0.6-0.7	0.29	0.18-0.46	0.37	0.32-0.42	N
M283.1541T36	unknown	UPLC	0.63	33	0.52-0.77	0.47	0.18-0.63	0.52	0.2-0.81	Y
M389.1235T64	artemetin (putative)	UPLC	0.58	1.4	0.54-0.63	0.49	0.44-0.51	0.94	0.94-0.94	Y
M107T472	myrtenal	GC	0.51	4.8	0.51-0.51	0.07	0-0.11	0.047	0-0.12	N

Increases were noted in 32 and decreases in one Artemis-extant metabolites, relative to Artemis. This hybrid differed the most from Artemis in terms of the number of metabolites. However, no metabolites lacking in Artemis were detected. Many differences can be attributed to increases in putative sesquiterpenes (M2xx).

Hyb8001r

该杂交品种生长速度快、干叶产量高，适合在中国、乌干达和马达加斯加种植

- 已在位于中国、印度、马达加斯加和乌干达的 13 个独立试点试种；于 2011 年 7 月 - 10 月间完成收获
- 最高青蒿素含量为 1.44% (马达加斯加)
- 最高干叶产量为 4488 公斤/公顷 (中国)
- 最高青蒿素产量预计可达 54.5 公斤/公顷 (马达加斯加)

