Supplementary Material

Figure S1. Expression and purification of *S. exigua* OBP2 in a bacterial system. The bacterial extracts before (lane 1) and after (lane 2) 0.2 mM IPTG induction, and the supernatant (lane 3) and the pellet (lane 4) after sonication were analyzed by SDS-PAGE. The recombinant protein with His-tag (lane 5) was first purified, and after digestion of recombinant enterokinase the solution containing the target protein (lane 6) was re-purified. M: Protein molecular weight marker of 97.2, 66.4, 44.3, 29.0, 20.1 and 14.3 kDa.

Table S1. Primers for identification, expression pattern analysis and prokaryotic expression of *S. exigua* chemosensory genes.

Table S2. The accession numbers of SNMPs used in the phylogenetic tree.

Table S3. The identified candidate *S. exigua* chemosensory genes.

Table S4. Amino acid sequences of identified candidate *S. exigua* ORs, GRs, IRs and *C. suppressalis*, *S. inferens* and *P. xylostella* SNMP3.

Table S5. Binding affinities of *S. exigua* OBP2 to different ligands.

Figure S1

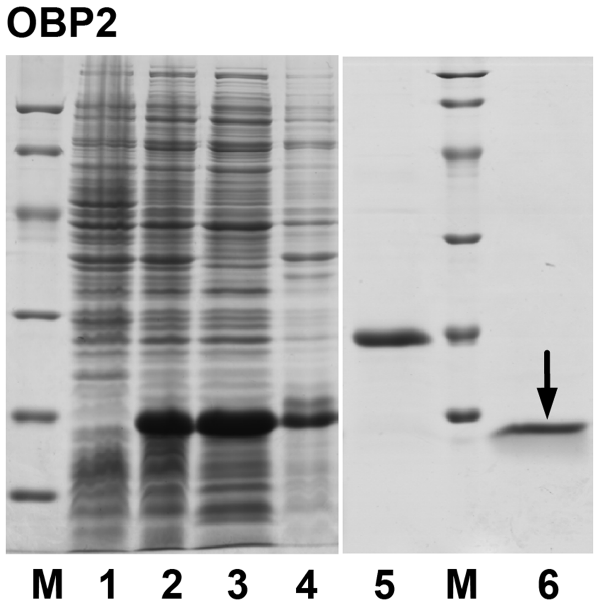

Table S1

Purpose	Gene	Sequence (5' to 3')
Expression pattern	OBP1-F†	AGCTGTGAAGCCATATATACAGGA
	OBP1-R‡	GAAACATGAAGTCAACAGCGC
	OBP2-F	GAGCGAATGCATCAAGGAAA
	OBP2-R	AGTACCCTGCTGATAGCATTTGA
	OBP3-F	TCCAAGGAGCCATAAAACCGT
	OBP3-R	GGCAATCACAGCAGTTTTATGCT
	OBP4-F	AATGAAGTGTAACAAGGACGGGA
	OBP4-R	ACTTGAATCCAAACTTGGGTGC
	OBP5-F	TGAGAAAAACTTGCCAACCGA
	OBP5-R	CGGGATTGTGATTGTAGATGCA
	OBP6-F	GACCTGAAGCAGAAATACGCG
	OBP6-R	CGAAGCTGAAATCAGGAGATTTC
	OBP7-F	GTACCAAGGAAGCCATGACCAC
	OBP7-R	CAATTTCCATCGACATCAGGC
	OBP8-F	TGATAGCAATGACTCGGAGCC
	OBP8-R	GCCGAAGATCTCTGGGAAGTT
	OBP9-F	AGCCAAAAGCCCATATAGAAGC
	OBP9-R	AAACTCGAGGTCAAATCCGAGT
	OBP10-F	TCAATGTATGCCGAAGAACTCTG
	OBP10-R	GGAAAGATGAAACTGTTTGGGTC
	OBP11-F	TGACAGATGAACAAAAAGCCCTC
	OBP11-R	CAAAGCCAAACTTGGAAGCATT
	OBP12-F	AGACGTGCTCAGCAAAAAACG
	OBP12-R	AAGGGAACATAAAATTGGCGG
	OBP13-F	GCGAGTCTCTGAGACCCGTTA
	OBP13-R	GCCTTATGGTCCAAGAAGCAA
	OBP14-F	GGACTGCAACAATGAACACCC
	OBP14-R	AATTTTATTCCCAGCTGCGG
	OBP15-F	AAGCCGGTGTTTAGTGACGAA
	OBP15-R	TGTGTACTTCAAACGCTCTCTGG
	OBP16-F	CAGTTGAAGAATTCTGGAAAGATGC
	OBP16-R	TCTGGTTTGAACTCGTACATGCAC
	OBP17-F	GTTCAAATGCTGCCCAATACC
	OBP17-R	CATGTGTTGTTGCAATGCCTG
	OBP18-F	CATGACCGAGTGCTTGAAGGA
	OBP18-R	TAGTTGTGATGCCAACGTGCA
	OBP20-F	GTAAGGAGGAGAAGGCGATGTT
	OBP20-R	GAGTTATTGTCGGACTCGTTCG
	OBP21-F	TTACGTGGAAGGTTTGAGGGAG
	OBP21-R	TGTTCCAGTTGGCTTGAGCATA
	OBP22-F	GATTCTGAGTCAAGATGCCGC

OBP22-R	GTCGAAGGAGACATCGCAGTT
OBP23-F	TCACCGATGTTGTGGTTACTGG
OBP23-R	TTAGCTCCGATCTCGATGATCAC
OBP24-F	AGAGAAGGAAGCATTCCGTGAG
OBP24-R	CTTTGTGCTCCAAGAAGCACC
OBP25-F	TGAGTGCCATGAAACCAATAGTG
OBP25-R	GAATTATCCACATCGTATTCGCC
OBP26-F	TTGAGACCCCAACCAAAAGAGA
OBP26-R	CTAACACTTCCACGCAGCTTCA
OBP27-F	TGTGTTGAATCTAGAAGCGGCT
OBP27-R	GGCATTACAGGAACCGATAGG
OBP28-F	AGAAACTCAAGAAGCACCGCA
OBP28-R	GCTTGGGGTCTTTTTCATGGT
OBP29-F	AAGAACCAGGCGAAATGAACC
OBP29-R	GGATTCCCTTTACCGTCAACC
ABPx-F	CGCTCGTGGAGCAAGTCAA
ABPx-R	CGTTCTGCCAGCACTGCTG
ABP2-F	CAGGTGTAAGAGATGCTTTGCG
ABP2-R	GTCCATCTTCTTTTTAGTTTCGGC
CSP1-F	GGAGCACCTACACCGACAGATA
CSP1-R	TTTGGACTGAGGGTCGTATTTG
CSP2-F	ACACCGACCGCTACGACAAT
CSP2-R	AGGCCTTGATCTTCTTGAGTTCC
CSP3-F	CACGACTCCCACTACACCGA
CSP3-R	CCTTCAGGGTCGTATTTGGC
CSP4-F	AGGACAAGTACAGCACGGAGAAT
CSP4-R	TTAAGAAGAGGCTACGGCTGCT
CSP5-F	CGATTACTACGAAATTGATACGTTG
CSP5-R	TCGATATAGCCTTCTCGAAAGC
CSP6-F	CCTCCACCTACACCGACAAGT
CSP6-R	TACTGTCGCTTGACGGCATC
CSP7-F	CACCAGCAAGTACGACAACATTG
CSP7-R	ATTCTGGGATTATGATGCCGTT
CSP8-F	CCTCAAATGACAGACGCACAAT
CSP8-R	TAACCGTATTGGCGGACAATT
CSP9-F	CAGACAGATACGACCACATCAACA
CSP9-R	GCAGCGAGGAAGGTTTCATAGT
CSP10-F	TCGCTACGAGAACTTCAATCCTG
CSP10-R	CAAGGAAAGCGTACAAGGCATC
CSP11-F	CGATAACTTTGACGTGGACACC
CSP11-R	GAATTTGTCGAAGTTACCGCG
CSP12-F	TCCTGACGACGGTTTCTATGAC
CSP12-R	GGTCGTCATGATGCTTATGCTC
CSP13-F	CAACTTCGATGTCGAGGCATT

CSP13-R	CTTTGGCGTTCAAGAATCTGG
CSP14-F	GCAGTGAAGGTCATCAAACGGT
CSP14-R	TCATCATTGTGGGTCTGGGTG
CSP15-F	GTGCCCCTAACAAAAGACGAAT
CSP15-R	TCCTTCTTAGTAGCCATTTTCTGC
CSP16-F	TAGATGTGGACAAGATTCTGGGTG
CSP16-R	GTCTGTACCGATGACGAAAGCAC
CSP17-F	GTACGACAGTTTTGACGTTCAACC
CSP17-R	TCTGCTAAGAATTTGTCGAAGGAG
CSP18-F	GACCATTACACCGACCGCTT
CSP18-R	GATGACATCCTCAACAATCCTCG
CSP19-F	GTATGATAATGTAAACGGGGAGGC
CSP19-R	CAGCAACAGACGCTTCGAACT
CSP20-F	AAAGGCCTCCAGTCTCCGAC
CSP20-R	CTATCCTGCGTATTGGCGAAC
OR3-F	ACCTTCGACATGTGGTTTCCA
OR3-R	GCGCTGACCAAGTGCCATAT
OR4-F	CAAGACGCTTCCAGCTTCAAG
OR4-R	GTTATCCATATGTGTGAACCCGG
OR5-F	AACAGAGTTCGATGGGGATGG
OR5-R	TCTTTCTTTCCCAACACAGCG
OR7-F	ATGGCACTGAGTTATGCAATGG
OR7-R	TAAGGTGGTGAGTAATGCGGC
OR8-F	TCAAACGTCAGTGCCCTCCTA
OR8-R	TCGCTCTCGAACCAGTAACCTT
OR9-F	CCACTCCTGGCGAGACCTATG
OR9-R	TCGTCGACTGACTCTCTCCCTG
OR11-F	CCCTTTCGCGTTACTTACCAC
OR11-R	TAAAACGTGCGCAAGAAAGC
OR12-F	TCTTACAACAGCTATCCTGATCGC
OR12-R	TGTATGACCTTGGAACCTACTCCA
GR1-F	AGTTCTTTGTGTGGTGTACTGTGTTG
GR1-R	TTTGGGGATTTCGGAGTCAGT
GR5-F	GTCCTTCTTACGCTACATTCTGTTG
GR5-R	AAGAACAGCATCACTATAACTGGCA
GR6-F	CGGCATCATCTTAGCCATCCT
GR6-R	GAGACACAATGAGCCGAGGTTC
IR25a-F	GGAAGGAAATGAGCCTAAACGA
IR25a-R	ATGGAGATTCCGTCAGATTGGT
IR68a-F	TGTGGATAGCAGTTCTCTTGGTG
IR68a-R	ACAGGTGACTTTGCTATCGACG
IR76b-F	AGGTGTGTGGGTTATGATGCTG
IR76b-R	TGGAGTCTCAATCGCGAGAGTA
IR87a-F	AACCCACTCCTAATGACAACCG

	IR87a-R	TTGCCAGAGGATTCCAAGTTG
	IR93a-F	ACATGGTGGTTGATGGTACTGGT
	IR93a-R	GGCACTATCATTGCGACTTTCTC
	SNMP1-F	CTGGTCCAGGTCTCACAGGAG
	SNMP1-R	GGTACAAGTGGCCTTCGGAG
	SNMP2-F	CTTTGATGGCATCTACTTGAGCTG
	SNMP2-R	ATCTGTTGTTCGGATTGGCACT
	SNMP3-F	TATCATCCAAGTTGCCGAGACA
	SNMP3-R	GTGGGTATATTCCAGCATCGGT
	GAPDH-F	CATAGAAAAGGCGTCTGCTCACT
	GAPDH-R	GCAGGAATGACTTTGCCGAC
RACE	OBP1-3'GSP[§]	ACATGTTTGGTTTTGTGCGTTGTGGC
	OBP1-5'GSP	CATGAACCCCACTCAGGCAACCAGC
	OBP2-3'GSP	GTTTGCTTCATAAGCTGACGGGGGTCT
	OBP2-5'GSP	TGTCCACTCCAGATAGCAGTTTCGCA
	OBP3-3'GSP	GCAAACGAGAAATCTGTCGGAGACG
	OBP3-5'GSP	GTCCAGCCAGACCCCTGTTTTTCAG
	OBP4-3'GSP	GGTTAACGCAAAGAAAATGGCGGAT
	OBP4-5'GSP	CCTTTGGCATTCATAACTTCGGCAG
	OBP5-3'GSP	CCAATTGCCGAGGGTGTGTTCATTG
	OBP5-5'GSP	CAAATCACCCTGTTTTATGG
	OBP6-3'GSP	CAGCAGTACCCGTTGGATCGTGCTG
	OBP6-5'GSP	TGCGTCAGCACGATCCAACGGGTAC
	OBP8-3'GSP	AACGCCCATGCACTGAAGCCATGT
	OBP8-5'GSP	TTCCATCGCTCACTGGTGCATCGT
	OBP9-3'GSP	GCAAAGTTCTTGACAGTTGGCGCAG
	OBP9-5'GSP	AGAGGGTGTTCCTTAATACATTCTGCGC
	OBP10-3'GSP	ACTTGATATGGCGCTCATCACAAAGCA
	OBP10-5'GSP	TTGTCCTGGCTGTGTAGGCACGCTG
	OBP11-3'GSP	TCGCCGATTTACGAGCAAGGAAGA
	OBP11-5'GSP	AGCATGGGGCATTTGGACCACTCG
	OBP12-3'GSP	CCCGAATGATATGAAGGCACCCGTT
	OBP12-5'GSP	TTTGCTGTCCAATAGGATGCTTCGC
	OBP14-3'GSP	GTATGGACTGCAACAATGAACACCCTT
	OBP14-5'GSP	GCTTCGTCGTTCACTTTCTTACAGGCTT
	OBP15-3'GSP	GCTTGTATCTACGAATTGACGAATGTGA
	OBP15-5'GSP	AAGATCGATTTGTTTGATCGATGCTTCA
	OBP16-3'GSP	AGTGTGTCGCTAAAACAGGGGTCGC
	OBP16-5'GSP	CTCGTCCGGTATCAGACTGACCAGCA
qPCR	OBP1-F	TGGCATCAACGCTTGCTTCTTAC
	OBP1-R	GGCTTTATCGGCATCGTATTCTCC
	OBP2-F	AAGAAAGGGATCATTAGCGAAGACC

	OBP2-R	TGCCTCAGATTTGTCCACTCCAG
	OBP3-F	CTGTCGGAGACGGAGATGCTG
	OBP3-R	ATATGAGTCATTACGCTGCTTAGGC
	OBP4-F	AAGAATGGAGATGAGAAACGACTGG
	OBP4-R	GAATATCATAGCGGCTCGGTCAC
	OBP5-F	CTAAGGAAGCCATTACTGC
	OBP5-R	CGGGATTGTGATTGTAGATG
	OBP6-F	CAGTAGAAGGTGTCAATGC
	OBP6-R	CTCTTGCTCCATCGCTAA
	OBP8-F	AAGCAGATGATAGCAATGAC
	OBP8-R	GGAATTTGTGGAAATGGGA
	OBP9-F	GACGAAGAAGTGTCTGATG
	OBP9-R	GTCAAATCCGAGTTGTTCA
	OBP10-F	CAGGAAGCAGTTATGGAATG
	OBP10-R	TAACAGAGTTCTTCGGCATA
	OBP11-F	GTTATGGATGACAAGGGTATG
	OBP11-R	GTGAGCACGAATGAAGATAA
	OBP12-F	TGGGACAGAGCGTTAAG
	OBP12-R	GGTGCCTTCATATCATTCG
	OBP14-F	GCAGACAGTTCAATAGCAAT
	OBP14-R	TTCGTCGTTCACTTTCTTAC
	OBP15-F	GCTGCTGTGGAGAAATG
	OBP15-R	TCTTCTGGTTTGAACTCGTA
	OBP16-F	CGGCATATTTAAGGAGGATG
	OBP16-R	GACTGACCAGCATATCGTA
	GAPDH-F	GACAACCACTCATCTATCTTCG
	GAPDH-R	AACATTTATCTCTACAACGCAATC
	EF-F	TGATGCCACAGACAAGAG
	EF-R	CCATTTCCACAAGTTCTACC
Prokaryotic expression	OBP2-F	CGGGATCCAATGAAAAGGGTAACAAACTCGC
	OBP2-R	CCGCTCGAGTTATGAAGCAAACATGATGTGTGAT

†Forward primer.

‡Reverse primer.

§Gene specific primer.

Restriction enzyme sites are underlined.

Table S2

Protein name	Accession number	Protein name	Accession number
AipsSNMP1	AGF87119	Onub-ESNMP1	ADQ73893
AipsSNMP2	AGF87120	Onub-ESNMP2	ADQ73890
ApolSNMP1	AAC47540	PxylSNMP1	You et al. 2013
ApolSNMP2	CAP19029	PxylSNMP2	You et al. 2013
AtraSNMP1	ACX47899	PxylSNMP3	In this study
BmorSNMP1	NP_001037186	SexiSNMP1	AGN52676
BmorSNMP2-like-1	XP_004933211	SexiSNMP2	AGN52677
BmorSNMP2-like-2	XP_004928125	SinfSNMP1	AGY49250
CsupSNMP1	AFS50073	SinfSNMP2	AGY49251
CsupSNMP2	AFS50074	SinfSNMP3	In this study
CsupSNMP3	In this study	SlitSNMP1	Legeai et al. 2011
CmedSNMP1	AFG73002	SlitSNMP2	Legeai et al. 2011
CmedSNMP2	AFG73003	SlituSNMP1	AGN48098
HarmSNMP1	Liu et al. 2014	SlituSNMP2	AGN48099
HarmSNMP2	Liu et al. 2014	SlituSNMP3	KP729048
HassSNMP1	Xu et al. 2014	SnonSNMP1	Glaser et al. 2013
HassSNMP2	Xu et al. 2014	SnonSNMP2	Glaser et al. 2013
HvirSNMP1	CAB65739	DmelSNMP1	Q9VDD3
HvirSNMP2	CAP19028	DmelSNMP2	E1JI63
MbraSNMP1	AAO15603	DmelEMP-B	AAM70803
MsexSNMP1	AAG49366	DmelCrq-A	AAM70803
MsexSNMP2	AAG49365	DmelCG2736	AAF47308
OfurSNMP1	ADQ73894	DmelPes	ACL83014
OfurSNMP2	ADQ73891	TcasSNMP1	XP_001816436
Onub-ZSNMP1	ADQ73892	TcasSNMP2	XP_970008
Onub-ZSNMP2	ADQ73889		

Table S3

Gene	Accession No.	ORF (AA)	Full length	NCBI Blast Hit (References/Name/Species)	E value	Identity (%)
Odorant binding proteins						
PBP1		164	Y	AAU95536 pheromone binding protein 1 [*Spodoptera exigua*]	1e-115	99
PBP2		168	N	AAS55551 pheromone binding protein 2 [*Spodoptera exigua*]	2e-120	99
PBP3		164	Y	ACY78413 pheromone binding protein 3 [*Spodoptera exigua*]	9e-116	100
GOBP1		164	Y	ACY78412 general binding protein 1 [*Spodoptera exigua*]	2e-117	99
GOBP2		162	Y	AGH70098 odorant binding protein 2 [*Spodoptera exigua*]	3e-113	99
OBP1	ADY17883	147	Y	AAR28762 odorant-binding protein [*Spodoptera frugiperda*]	1e-85	88
OBP2	ADY17884	129	Y	AFI57167 odorant-binding protein 18 [*Helicoverpa armigera*]	2e-43	65
OBP3	ADY17885	147	Y	AEX07271 odorant-binding protein [*Helicoverpa assulta*]	1e-37	44
OBP4	ADY17886	145	Y	AEX07279 odorant-binding protein [*Helicoverpa armigera*]	8e-80	81
OBP5	AFM77983	121	Y	AEB54589 OBP8 [*Helicoverpa armigera*]	3e-73	88
OBP6	AFM77984	147	Y	AII00976 odorant binding protein [*Dendrolimus houi*]	2e-47	50
OBP7	ADY17882	157	Y	AGH70106 odorant binding protein 10 [*Spodoptera exigua*]	1e-109	99
OBP8	AGP03454	151	Y	AGR39565 odorant binding protein 2 [*Agrotis ipsilon*]	6e-26	42
OBP9	AGP03455	153	Y	XP_004928233 PREDICTED: general odorant-binding protein 99a-like [*Bombyx mori*]	2e-56	58
OBP10	AGP03456	140	Y	AGS36755 OBP15, partial [*Sesamia inferens*]	3e-53	74
OBP11	AGP03457	154	Y	ADK47525 odorant binding protein [*Manduca sexta*]	9e-66	66
OBP12	AGP03458	145	Y	AGM38613 odorant binding protein [*Chilo suppressalis*]	4e-55	55
OBP13	AGP03459	145	Y	AAR28763 odorant-binding protein-2 precursor [*Spodoptera frugiperda*]	4e-64	75
OBP14	AGP03460	139	Y	AII00969 odorant binding protein [*Dendrolimus houi*]	2e-43	49
OBP15		142	Y	AGH70103 odorant binding protein 7 [*Spodoptera exigua*]	6e-97	100
OBP16		149	Y	AGH70104 odorant binding protein 8 [*Spodoptera exigua*]	1e-103	99
OBP17	KP729037	148	Y	AGR39569 odorant binding protein 6, partial [*Agrotis ipsilon*]	1e-64	78
OBP18	KP729038	186	Y	AGR39564 odorant binding protein 1, partial [*Agrotis ipsilon*]	2e-72	58

OBP19	KP729039	216	Y	AGC92793 odorant-binding protein 19 [*Helicoverpa assulta*]	8e-63	54
OBP20	KP729040	146	N	AIL54057 odorant-binding protein 21, partial [*Chilo suppressalis*]	6e-61	69
OBP21		65	N	XP_004922682 PREDICTED: uncharacterized protein LOC101744305 [*Bombyx mori*]	1e-29	73
OBP22	KP729041	156	Y	AGK24578 odorant-binding protein 2 [*Chilo suppressalis*]	7e-17	33
OBP24	KP729043	184	Y	AII00978 odorant binding protein [*Dendrolimus houi*]	7e-124	93
OBP26	KP729045	149	Y	AEB54581 OBP5 [*Helicoverpa armigera*]	2e-57	60
OBP27	KP729046	97	N	AAR28762 odorant-binding protein [*Spodoptera frugiperda*]	1e-27	56
OBP28		133	Y	AGH70105 odorant binding protein 9 [*Spodoptera exigua*]	2e-91	100
OBP29		123	N	AGH70107 odorant binding protein 11 [*Spodoptera exigua*]	2e-81	98
ABP2		147	Y	ADY17881 antennal binding protein [*Spodoptera exigua*]	1e-98	99
ABPx	AGP03461	142	Y	CAA05508 antennal binding protein X [*Heliothis virescens*]	7e-64	80
Chemosensory proteins						
CSP1		128	Y	ABM67688 chemosensory protein CSP1 [*Spodoptera exigua*]	4e-89	100
CSP2		128	Y	ABM67689 chemosensory protein CSP2 [*Spodoptera exigua*]	1e-86	99
CSP3		126	Y	ABM67690 chemosensory protein CSP3 [*Spodoptera exigua*]	2e-85	98
CSP4	KP729023	123	Y	AFR92092 chemosensory protein 8 [*Helicoverpa armigera*]	8e-55	70
CSP5	KP729024	131	Y	NP_001091781 chemosensory protein 15 [*Bombyx mori*]	6e-44	73
CSP6	KP729025	122	Y	AGR39576 chemosensory protein 6 [*Agrotis ipsilon*]	1e-72	83
CSP7	KP729026	128	Y	AIU68827 chemosensory protein [*Chilo auricilius*]	4e-78	89
CSP8	KP729027	107	Y	AII01044 chemosensory protein [*Dendrolimus kikuchii*]	7e-51	75
CSP9		123	Y	AGR39578 chemosensory protein 8 [*Agrotis ipsilon*]	9e-79	90
CSP10	KP729028	122	Y	BAG71921 chemosensory protein 13 [*Papilio xuthus*]	3e-65	77
CSP11	KP729029	122	Y	AFR92094 chemosensory protein 10 [*Helicoverpa armigera*]	2e-75	90
CSP12	KP729030	125	Y	NP_001037066 chemosensory protein precursor [*Bombyx mori*]	6e-46	60
CSP13	KP729031	123	Y	AIW65100 chemosensory protein [*Helicoverpa armigera*]	6e-72	83
CSP14	KP729032	287	Y	AIW65104 chemosensory protein [*Helicoverpa armigera*]	4e-157	84
CSP15		111	Y	AEX07268 CSP7 [*Helicoverpa armigera*]	1e-35	51

CSP16	KP729033	122	Y	EHJ73331 chemosensory protein 12 [*Danaus plexippus*]	3e-40	63
CSP17		122	Y	AEX07267 CSP6 [*Helicoverpa armigera*]	2e-73	88
CSP18	KP729034	117	Y	ABM67689 chemosensory protein CSP2 [*Spodoptera exigua*]	2e-39	58
CSP19	KP729035	122	Y	AGR20054 chemosensory protein 16, partial [*Helicoverpa armigera*]	1e-38	49
CSP20	KP729036	107	Y	AGR39575 chemosensory protein 5 [*Agrotis ipsilon*]	5e-66	93
Sensory neuron membrane proteins						
SNMP1		87	N	AGN52676 sensory neuron membrane protein 1 [*Spodoptera exigua*]	1e-52	99
SNMP2		520	Y	AGN52677 sensory neuron membrane protein 2 [*Spodoptera exigua*]	0.0	99
SNMP3	KP729047	529	Y	XP_004933211 PREDICTED: sensory neuron membrane protein 2-like [*Bombyx mori*]	0.0	55
Odorant receptors						
OR1		65	N	AGY14588 putative odorant receptor, partial [*Sesamia inferens*]	6e-26	72
OR3		136	N	EHJ75442 odorant receptor 3 [*Danaus plexippus*]	6e-40	45
OR4		101	N	AIT69896 olfactory receptor 47, partial [*Ctenopseustis herana*]	8e-43	72
OR5		75	N	AIG51876 odorant receptor, partial [*Helicoverpa armigera*]	2e-35	77
OR7		87	N	NP_001166893 olfactory receptor 27 [*Bombyx mori*]	5e-29	64
OR8		145	N	AIG51882 odorant receptor, partial [*Helicoverpa armigera*]	8e-61	68
OR9		95	N	AIG51900 odorant receptor, partial [*Helicoverpa armigera*]	8e-35	71
OR10		57	N	AIG51858 olfactory receptor, partial [*Helicoverpa armigera*]	6e-29	96
OR11		99	N	AGH58120 odorant receptor 11 [*Spodoptera exigua*]	2e-60	100
OR12		69	N	CAG38121 putative chemosensory receptor 20 [*Heliothis virescens*]	1e-17	67
Gustatory receptors						
GR1		121	N	EHJ69979 putative gustatory receptor candidate 59 [*Danaus plexippus*]	4e-21	80
GR2		37	N	AIG51908 gustatory receptor [*Helicoverpa armigera*]	3e-14	97
GR3		214	N	DAA06392 TPA_inf: gustatory receptor 58 [*Bombyx mori*]	1e-07	28
GR4		109	N	DAA06393 TPA_inf: gustatory receptor 61 [*Bombyx mori*]	0.002	32
GR5		133	N	DAA06391 TPA_inf: gustatory receptor 57 [*Bombyx mori*]	5e-12	29

GR6	413	N	AGA04648 gustatory receptor [*Helicoverpa armigera*]	0.0	89
Ionotropic receptors					
IR25a	657	N	AFC91757 putative ionotropic receptor IR25a [*Cydia pomonella*]	1e-130	83
IR68a	246	N	ADR64682 putative chemosensory ionotropic receptor IR68a [*Spodoptera littoralis*]	9e-78	93
IR75p	66	N	AIIO1118 ionotropic receptors, partial [*Dendrolimus houi*]	4e-21	62
IR76b	542	Y	ADR64687 putative chemosensory ionotropic receptor IR76b [*Spodoptera littoralis*]	0.0	93
IR87a	141	N	NP_650290 ionotropic receptor 87a [*Drosophila melanogaster*]	0.84	29
IR93a	413	N	AIG51923 ionotropic receptor, partial [*Helicoverpa armigera*]	0.0	83

Note: Newly identified candidate OBPs and CSPs, except for OBP21 due to a short sequence, were submitted to GenBank and the accession numbers of these genes are present in this table.

Table S4

>SexiOR1
PLLGQLAASGVLICFIGYQATATIGQSVVECMTSFLFLAYNLFDFYMICRWCQEITNQSAN
VGEA
>SexiOR3
LILRTFDMWFPWSLEDYTVYIISFIFHAYAGYLCCIAYPGLQSIIILLLGQIIRQIRILTFILLHM
XKVSLDTMKYYIHEFCFILVVLMFCLVGQQVDNECEALERAVTEKWYIFNHNHKSNIRIFN
MALGQRMSIY
>SexiOR4
KLQQDASSFKSVRLITSVAFFVAMILQLGMQCLTGNELTIQAERISDAIMQCKWERIPPSQ
RRLLLIMMMRAQRPLRLTAAGFTHMDNACFLAVSIKKFLV-
>SexiOR5
NYIFKQSSMGMGQGPFAAASWCLSPRIRRDLVILGSGMMKPRHLRAGPFNFLDLPSFIQ
VVRAAYSYYAVLGKKE-
>SexiOR7
SKVLAMALSYAMEDHLKELFDTCLTSRKFPQPWKEGRLVLLQKPGRPPDSPSAYRPIVL
LDEAGKMLERILASRITHHLSTVGPDLS
>SexiOR8
IVILTSNVSALLRLLQVDLENAIKIHDEDKNLKKNINVTDPESYENVRTLVIVHQKTFKNIGS
TEQCFWVVIFIHVAFAALEICFFGFLTLVYGGLADTIANLPTVFNAVFTIFLLSLSGQFLCDT
SSQVADAAYQGYWFESDVK
>SexiOR9
RYLPTTPGETYGLSPKYETPFYEITFVLTYVATAFSAINQTGYIVLFVTLICHELGHFYANH
GSTGRDSYNLDKERTFSKQRRQGTGRESVDDLL
>SexiOR10
MPVTPLKSPDYELGYLYQMVSIYISAFLFISVDSVAVCMIMFGCAELEIIMDKIQKV
>SexiOR11
TAAALSRYLPLTIIMFGELVLLSIIFETIGTMSEKLKDAVYKMPWEYMDTKNRRTVLIFLIKV
QEPIHVKAGGLVDVGVTTMASILKTSFSYFAFLRTF-
>SexiOR12
TIFLNDQFLTTAILIASISPLATMIFIDMYKCWMASDIVNIIRHSTVVGPFLGGFFKVREEWS
RFQGHT-

>SexiGR1
MYKSLIVLCVVYCVVIEARPKWQVLPPMPGYVPVYIRPGDTPLEEINLDLAEAFHELPSG
RSVGKQVEASPEAPEQADQPQPDEVPAAPADEIVDHRPYEKKILEKKKKTDSEIPKPIER
R

>SexiGR2
HVNRELLTSAISMIAIYLIVLLQFKISLPKDPQIVAT-
>SexiGR3
GIRILVLFNKYFDVWIESVYKMDNQQNNEEDCNKLVKLYRDILEAYKLFTAIFTVLIFFRTID
LFMRGLIYLYLYFIDFKYSHVEEEIHNYTIIATLIVGLDWMIKNIIIISAICMQCEKFQMHIEEA
ESACIQLVMKRDCPKSNKYLYKRVLQYNHLFTKMSAYGFFTFDAKLPMPLLGLLTNYII
VFIAVRFSFEFCTVCRNGMGEGFFYFY-
>SexiGR4
ENEYKIVSWNIIILTIIWLLKDIVLVFLQNFFSEKFYMTVEEAETTCILLMKNTNCTQNEKRL
CKKVLWEKRTFNKMAILGVSVGALLPISVIAHVTNYVIVLIQFAFL-
>SexiGR5
MSILMSFLRYILLTYQFFYKYTFNKTRATDYNRFIVIFTYVSVMMMPLAAGQMTRNQGVK
YHRVLARLYNKMIGTDANAEETKMIKDFIRLIKKNPLQINLISNFPAGMNLLPVIVMLFFNY
LIVILQFNHVI-
>SexiGR6
PSRPTHCVVGGAHAFILRISSFFGLAPLRFEARNNGFTVSISSAMCVYSYILVTVLVICTIF
GLVAEXTAGAGVYGAPQRMRNMLKFMENIASVDTSIGGQYSLLTERKLCGIILAILIFFSV
LIADDFTFYALQAKKLDREWDVVTNYLGFYLLWFVVLMLELQFAFTALSVRARFSAVNDA
LALTARQVSVPVEKPKIPSSLNIYAIRVAPADSARSANVSLLVETMTGREHVVIIKRTASG
EPRLIVSPCDAVRRLAALHGTLCDVVNSIDDSYGLPLIVVLISTLLHLIVTPYFLIMEIIVSTN
RVHFLVLQFLWCVTHMLRMIVVVEPGHYTIAEGKRTEALVCRLMTSAPSTGVLPSRLEIF
SRQLMLQSVSYAPMGMCTLHRPLVASVIGAVTTYLVILIQFQRYDS-

>SexiIR25a
MSARTVFLLIYFIRITFGQTTQNINVLLINEESNALAEKAFEVAKEYVRRNPSLGLAVDPVI
VVGNRTXSFTEALSLPTISGSFGQVGDLRQWRSLNANQTRFLLQVMPPADILPEAIRAIV
TKQDITNAAIIFDEFXCGCKNATIVHIRPTPDANSRDRLGKIKTTYSMNGEPEITSAFYFDL
SLRTFLTIKSLLDSGKWPNDMKYITCDDYDGKNTPNRTLDLKTAFQEIKETPTYAPFYIPP
DDPMNGRSYMEFSTDLLAITVKDGASISSHSLGSWKAGLSSNLTLXTMDENGNWNGIIK
ELVDKKADIGLSSLSVMAERENVVDFTVPYYDLVGITIMMKLPRTPTSLFKFLTVLENDV
WLSILAAYFFTSFLMWVFDKWSPYSYQNNREKYKEDEEKREFTLKECLWFCMTSLTPQ
GGGEAPKNLSGRLLXIWKEMSLNDSLKEVERAKLAVWDYPVSDKYSKMWQAMEEAVL
PNTIEEAIQRVRDSKSSSEGFAWLGDATDVKYHVMTSCDLQSVGDEFSRKPYAIAVQQ
GSPLKDQFNNAILQLLNKRKLEKLKEIWWNNNPESMKCEKQDDQSDGISIQNIGGVFIVIF
MGIGLACVTLGVEYWWYKWRKRPAVGDVTQVEPAKLTRNNVDKQGDGFNFRGRNLGI
NFKPKF-
>SexiIR68a

LTISFRLYMWIAVLLVLLITGTIFYGLAKNHMNLQEYKKLRVTQTKHDEDNDAKPGLYLFG
EIINSILYTYGMLLVVSLPRLPTGWSIRLLTGWYWLYCILLVVSYRASMTAILANPAPRVTI
DTLRELVDSKVTCGGXPISIGFHKNSPLKPLADVYMWRVVEVGLVEKWLNDVMYPIHSL
ETNEDEVKALMNLKKLYGAFIALAIGYTLSALCLTDELIHWHFIVKRDPNFDKYALHLYYR
KKNY-
>SexiIR75p
HSRYQTYNNQVRRSIYKRIDPEIGQKHFYNLDEGVERIRQGLFAFHSIVEPVYRQIEDTFL
ENEKC
>SexiIR76b
MAGIELIISSICNATFCEIPYNETYQAPDSLVEKDINFMSLMKEVNGKHIKVTTYNNTPLSS
TEFENGTVVGYGVAFTIMNILRKKFNFTYEIILPTKNYELGSKISDDSIIGLLNTSKVDMAVA
FLPTLLPYREKVSFSIDLDEGVWVMMLKRPKESAAGSGLLAPFNDLVWYLVLAAVLTFG
PCITFFTRVRSKLITDDEGVLPLKPSFWFVYSAFLKQGTNLSPEANTTRVLFVTWWLFMI
LLSAFYTANLTAFLTLSKFTLAIETPRDLYQKNTRWVASAGSSVEHVVKTEGEDLYFLNA
MISSGKARFLSVSGDKEFLEYVKKEAVLVKEQTVVDHLMYNDYISKKDVDESDKCTYVV
APSAFMKKQRAFAYPVGSKLKSLFDPVLTQIFQAGILDFLKRSDLPSTKICPLDLQSKDRK
LRNSDLIMTYLVMVAGSATAVAVFGAEIFVKRYLSGKLNKTKKSKRKKSKAGKSSKIHND
SRPPPYDSLFGKNPKFNLETTRMKMINGREYYVFETSNGDKKLIPARAPSSFLYRSDK-
>SexiIR87a
MFAFLRTVLFFIHFTSSMSENPLLMTTANSGQIAKTAECVLKLSAKYFVEKKALSGSIVIINI
NSYTSTTQXFYPHANASHFPEKAKNYMLILEEKSELKRNILQLNKLPTWNPLAKAIVFYQL
KYNETAEETAVDFINELR
>SexiIR93a
LLNVGIWRPIDGVRFEDVLFPHIHHGFRGKELPIITYHNPPWTILQRNESGAIVKYGGLIFD
IIHQLAINKNFTVKVILASVLKKELSNDTTTDMMHSMEAKLTISAIAKGQGALAAASFTVLA
DPVPGVXPSGAQQSIIILLPFTTDTWLCLGLAVILMGPTLYIIHRMSPYYEAMEITRQGGLA
TIHNCLWYIYGALLQQGGMYLPRADSGRLVVGTWWLMVLVVVTTYSGNLVAFLTFPKQ
EVPVTTISDLLANRALYTWSINKGSYLEMELKNSDEPKYLALLKGAELVSPTDGKSGTMS
SGSSLLQRVRFHRHVIIDWKLRLSYMMRADRLEDDNCDFALSTEEFLDEKVAMIVPAGS
PYLPVINKELDRMHKAGLIMRWLEAYLPKKDRCWKSSSMMQEVEQPHCQPQ-

>CsupSNMP3
MCSGFVCGLVTIVIGAALVISSSIVGFVVVPNIVKEGIVNQVALMDDTIQLERFTEVPFPLQ
CRVRVFNISNAAEVLEGAVPIVTEMGPYVYKLYSSRLIEERTDDRLRYRKLDRFEFDAVA
SFPYTENXVLQVAERRFPGVMTVLNEALPEIFEEYNKPIVPVRVRDLIFDGMPLCRNPSY
VGTLACIIIRQISNDIQNMMPQPDGSIHFSVLNYRNGIPGGLMDVYRGLDDPADLGRIINW
QSSPNLSYWTGANSLCNMLNGTDSGIFQPFINREPRNLLRRFGFTSDICRSVELRYQHD
IVHNDIPGVRFAAREWLLNNNEGCFCLNITSGINAEDGCLLNGAMELFSCVGAYMVLSN

PHFLFGDIRYRNGVFGMNPVIDKHGIFLDIEPNTGTILRGSKRAQFNVFMRPVTRVHATQ
KLRTTLTPIFWIEEAMTLPEEYTDEIS

>PxylSNMP3

MKFGVRSSAAVLAVGAVVAVAVAIVGYAVVPGIIDETILQEVALENNTIALERFENVPFPL
NFTIHLFSVENGPEVLAGGIPRVRERGPYIYKLYQTRVIEGFNEDTISYRFLQTYEFDKEA
SFPNTEDDRVTIANVAYHSVLQVAEQLAPTLLGALSLALDSVFGRELNSPLATVRVGDLV
FDGIPLCRGGGLLASVACAVIRDAAKDIPNMEVQPDGSLVFSLFAHKRDKLGELYKVDR
GLQDPLALGSILQWNQRDFLPNWAGGPLSQCARLNGTDTGIFPPFIKRDTVLYGFNTDI
CRSVELRYQYDTQYSGVPAYRFAANDWFLSNREGCFCLNVTAGVTAPDGCLLHGAQE
MYSCIEPTLGYLVCARKKDYIISGHSILTDDSYSISRVEALGGGWHTTSSPVAVKSNRGT
ALSPTEIAGSYLVLTYPHFLFAHPTYANMVVGMTPDLERHRIFLDLEPVSTPYFLRKV

>SinfSNMP3

QRTGLNREDGCLLKGAMELYTCVGAFLVMSYP

Table S5

Ligand	OBP2		
	Relative fluorescence (%)	IC_{50} (μM)	K_i (μM)
Alcohols			
Hexanol	65.70	—	
Z-2-Hexenol	72.64	—	
Z-3-Hexenol	81.17	—	
E-3-Hexenol	74.86	—	
Heptanol	61.77	—	
2-Heptanol	69.09	—	
Nonanol	53.56	—	
2-Hexyl-1-decanol	70.98 (66.09)	—	
undecanol	34.23	**4.99**	**3.60**
Hexadecanol	67.50	—	
Linalool	63.05	—	
(+)-Cedrol	66.97	—	
Nerolidol	66.46	—	
Farnesol	50.56	—	
Geraniol	67.19	—	
α-Ionol	74.04	—	
β-Citronellol	70.42	— —	
S-*Z*-Verbenol	79.22	—	
(+)-Borneol	77.75	—	
Menthol	78.08	—	
(1*R*)-(−)-Myrtenol	71.23	—	
Phenethyl alcohol	71.23	—	
Aldehydes			
Hexanal	80.10	—	
E-2-Hexenal	67.76	—	
Z-3-Hexenal	66.90	—	
Heptanal	74.07	—	
Octanal	67.62	—	
Decanal	58.89	—	
Dodecyl aldehyde	40.69	**6.96**	**5.03**

Benzaldehyde	66.42	—	
Ketones			
2-Hexanone	78.87	—	
2-Tridecanone	60.29	—	
2-Pentadecanone	44.61	**11.06**	**7.99**
Geranylacetone	61.02	—	
β-Ionone	64.26	—	
Damascenone	71.55	—	
(+)-Carvone	72.83	—	
Acetophenone	69.65	—	
Esters			
Butyl acetate	63.34	—	
Amyl acetate	66.94	—	
Isoamyl acetate	76.52	—	
Hexyl acetate	70.54	—	
Heptyl acetate	59.14	—	
Octyl acetate	43.11	**7.99**	**5.77**
Nonyl acetate	42.75	**11.68**	**8.44**
Decyl acetate	40.06	**6.74**	**4.87**
Z-3-Hexenyl acetate	71.16	—	
E-2-Hexenyl butyrate	63.87	—	
Z-2-Hexenyl butyrate	62.89	—	
Geranyl acetate	62.64	—	
Methyl salicylate	71.56	—	
Methyl benzoate	73.25	—	
Alkanes			
Undecane	60.86	—	
Dodecane	68.28	—	
Tridecane	75.78	—	
Tetradecane	74.02	—	
Heptadecane	82.76	—	
Octadecane	83.33	—	
Icosane	77.90	—	
Olefines			
Myrcene	64.73	—	

E-β-Farnesene	70.04	—	
Ocimene	83.09	—	
(+)-α-Pinene	68.76	—	
(+)-β-Pinene	73.19	—	
(*R*)-(+)-Limonene	67.37	—	
α-Phellandrene	67.09	—	
(+)-Camphene	76.45	—	
β-Caryophyllene	75.74	—	
Others			
Eucalyptol	70.04	—	
Camphor	72.81	—	
Cumene	69.15	—	
Lauric acid	37.30 (36.40)	**2.99**	**2.16**

Note: Relative fluorescence means the fluorescent percent as fluorescence intensity at the maximal concentration of 20 μM relative to the initial fluorescence. The values in the bracket indicates that at 20 μM relative fluorescence values of these ligands are not the lowest values and are shown at other concentrations. In binding assays, IC_{50} values (the concentrations of the ligands halving the fluorescence of 1-NPN) of the ligands at 20 μM could be not obtained and represented as “—”.